Nganhurra Operations Cessation Environment Plan

Developments Division
Revision 6
1st October

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1 INTRODUCTION

1.1 Overview

Woodside Energy Ltd (Woodside), as Titleholder, under the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*) (referred to as the Environment Regulations), operates the Enfield reservoir within Production Licence Area WA-28-L (referred to as WA-28-L). This Environment Plan (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).

The activities described in this EP relate to initial decommissioning of the Enfield reservoir. In December 2017, NOPSEMA accepted Revision 2 of this EP. Activities described in Revision 2 of this EP commenced in Q4 2018 when the Nganhurra floating production, storage, and offtake facility (FPSO) was used to flush, isolate and preserve the riser turret mooring (RTM) and the subsea infrastructure, before the FPSO was disconnected and removed from the title area. During the activities undertaken in 2018, it was determined that modification to the activities for decommissioning the RTM is required. As such, a revised EP is required under Regulation 17(5) of the Environment Regulations.

Under Revision 2 of this EP, Woodside had planned to decommission the Nganhurra RTM by ballasting the column as per design and rotating it into a horizontal position followed by wet tow to Henderson, Western Australia (WA) for removal and onshore disposal. This methodology was unable to be executed because a failure was identified within internal compartment 2, near the base of the RTM, which meant it was not possible to deballast the compartment (**Section 3.6.1.1**). This compartment is necessary for deballasting and the failure prevents the RTM from being rotated to horizontal.

Internal review by Woodside has identified factors associated with the design and maintenance of the RTM that have led to this failure, including:

- The Nganhurra RTM design was completed in 2003, with the concept based on a similar FPSO design from the early 1990s. At that time, designing for decommissioning execution was less robust than in modern design processes. For example, some more recent RTMs feature external ballast that allow for offshore ballast removal before onshore disposal.
- After installation, the base of the Nganhurra RTM (compartment 1) was, by design, filled offshore with 325 tonnes of iron ore slurry to provide ballast. Removing this ballast is not practicable. The additional weight at the base of the RTM increases draft and makes rotation to the horizontal position (required for onshore disposal) much more difficult—the evacuation of compartment 2 (to create buoyancy) is critical. Refer to **Section 3.6.3.2** for full practicability assessment of options to decommission the RTM.
- The presence of this ballast combined with the compartment 2 failure makes horizontal rotation of the RTM, and therefore onshore disposal, not practicable. The root cause of the failure is unexpected corrosion resulting from a late change to the RTM design. To eliminate wear on the outer sheath of flexible risers through the bend area within compartment 2, a layer of Inconel cladding was provided on the inside of the j-tubes which pass through the compartment. This change resulted in the unexpected consequence of galvanic corrosion, which has directly led to the internal failure of the j-tube. The RTM has a 20-year design life and this unforeseen design flaw resulted in failure of the compartment within 12 years. No other compartments are affected by this fault.
- Inspection of compartment 2 carries high health and safety risks as, by design, it was permanently partially filled with water and must be deballasted before personnel can enter. A decision was made in 2016 not to internally inspect the RTM (including compartment 2) due to the impending decision to bring forward the end of field life, the costs and risks to personnel

associated with this inspection, which would require confined space entry of compartments within the RTM column.

Lessons from this review will subsequently be taken forward into operations and future projects. Such as, decommissioning requirements are now included in the design phase for modern facilities, and a plan for reviewing critical equipment items required for decommissioning execution on operating assets is being developed. The intention of this review is to confirm that existing facility design incorporates robust decommissioning planning and allowance for maintenance to minimise the likelihood of single point equipment failures impacting decommissioning execution.

1.2 Defining the Petroleum Activities Program

The Petroleum Activities Program to be undertaken in WA-28-L comprises the activities defined in Regulation 4 of the Environment Regulations. Activities included in Revision 2 of this EP that have already been completed have been removed from this revision. The activities that form the scope of this revised EP, and will herein be referred to as the Petroleum Activities Program, include:

- implementing an inspection regime during a preservation period until all wells are abandoned and subsea infrastructure is decommissioned (which will be subject to a future, separate EP, refer to **Section 3.4**)
- inspection, monitoring, maintenance and repair (IMMR) activities to ensure integrity of subsea infrastructure
- well intervention, if required
- IMMR of the RTM while it remains on station
- disconnecting mooring lines from the RTM and laying them on the seabed (accepted as part of Revision 2)
- removing the RTM from the title area

In addition to the above, the impacts and risks associated with the above (as described by the following activities) have also been considered as part of the Petroleum Activities Program:

- towing the RTM to the proposed integrated artificial reef (IAR) site
- placing the RTM on the seabed and undertaking stabilisation and modification (removal of risers and grouting foam, etc.) activities for it to become part of an IAR
- augmenting the RTM by installing additional purpose-built reef modules to complete the IAR.

The assessment of the need for, and potential environmental impacts of, a proposal to place an IAR at sea is being sought by Recfishwest, through a permit for the proposed placement under Section 19 of the Commonwealth *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act). Towing and placing the RTM and purpose-built reef modules to form an IAR will be undertaken in accordance with an approved artificial reef permit.

Towing the RTM outside WA-28-L and installing it on the seabed as an IAR has been included as part of the revised Petroleum Activity Program on the basis that these consistute impacts and risks associated with the petroleum activity.

This EP also summarises the assessment of options evaluated for decommissioning the RTM following confirmation that the RTM removal activities described in the accepted EP were no longer practicable (**Section 3.6**). Options identified for decommissioning the RTM were assessed in terms of their practicability and whether they deliver equal or better environmental outcomes when compared to the currently accepted option for decommissioning. From this assessment, the preferred option for decommissioning is to donate the RTM so it can be repurposed as an IAR outside WA-28-L. An artificial reef permit for an IAR comprising the RTM and purpose-built reef structures, is currently being progressed by Recfishwest.

1.3 Purpose of the Environment Plan

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

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

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

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

1.4 Scope of the Environment Plan

This EP covers two Operational Areas (as defined in **Section 3.3.1**) which represents the area in which the Petroleum Activities Program is to be undertaken. The Petroleum Activities Program is described in detail in **Section 3**.

This EP addresses the potential environmental impacts from planned activities and any potential unplanned risks that originate from within the Operational Areas.

Transit to and from the Operational Areas by a Primary Installation Vessel (PIV), Mobile Offshore Drilling Unit (MODU), intervention vessel and support 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 Areas (e.g. transiting to and from port) are subject to all applicable maritime regulations and other requirements and are not managed by this EP.

1.5 Environment Plan Summary

This WA-28-L Nganhurra Operations Cessation EP summary has been prepared based on the material provided in this EP. This summarises the items listed in **Table 1-1** as required by Regulation 11(4).

Table 1-1: EP summary

EP summary material requirement	Relevant section of EP containing EP summary material
The location of the activity	**Section 3.3**, pages 41–45
A description of the receiving environment	**Section 4**, pages 124–213
A description of the activity	**Section 3**, pages 40– 124
Details of the environmental impacts and risks	**Section 6**, pages 254–480
The control measures for the activity	**Section 6**, pages 254–480
The arrangements for ongoing monitoring of the titleholder's environmental performance	**Section 7.5**, pages 498–499

EP summary material requirement	Relevant section of EP containing EP summary material
Response arrangements in the oil pollution emergency plan	**Section 7.9**, pages 507–510, and **Appendix D**
Consultation already undertaken and plans for ongoing consultation	**Section 5**, pages 214–252
Details of the titleholder's nominated liaison person for the activity	**Section 1.8**, page 18

1.6 Structure of the Environment Plan

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

Table 1-2: EP process phases, applicable 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' is applicable throughout the EP	**Section 2** **Section 3** **Section 4** **Section 5** **Section 6** **Section 7**
Regulation 10A(b) *demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable* Regulation 10A(c) *demonstrates that the environmental impacts and risks of the activity will be of an acceptable level*	Regulation 13(1) – 13(7) *13(1) Description of the activity* *13(2)(3) Description of the environment* *13(4) Requirements* *13(5)(6) Evaluation of environmental impacts and risks* *13(7) Environmental performance outcomes and standards* Regulation 16(a) – 16(c) *A statement of the titleholder's corporate environmental policy* *A report on all consultations between the titleholder and any relevant person*	Set the context (activity and existing environment) Define 'acceptable' (the requirements, the corporate policy, relevant persons) Detail the impacts and risks Evaluate to nature and scale Detail the control measures – ALARP and acceptable	**Section 1** **Section 2** **Section 3** **Section 4** **Section 5** **Section 3.6** **Section 6** **Section 7**
Regulation 10A(d) *provides for appropriate environmental performance outcomes, environmental performance standards and measurement criteria*	Regulation 13(7) *Environmental performance outcomes and standards*	Environmental performance outcomes Environmental performance standards Measurement criteria	**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: EMS Performance monitoring Oil Pollution Emergency Plan (OPEP) and scientific monitoring Ongoing consultation	**Section 7** **Appendix D**

Criteria for acceptance	Content Requirements/ Relevant Regulations	Elements	Section of EP
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 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.*	No activity, or part of the activity, undertaken in any part of a declared World Heritage property.	**Section 3** **Section 4** **Section 6**
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 13(4)a: *Describe the requirements, including legislative requirements, that apply to activity and are relevant to the environmental management of the activity* Regulation 15: *Details of the titleholder and liaison person* Regulation 16(a): *A statement of the titleholder's corporate environmental policy* Regulation 16(c): details of all reportable incidents in relation to the proposed activity.	All contents of the EP must comply with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and the Environment Regulations	**Section 1** **Section 5** **Section 6** **Appendix A** **Appendix B**

1.7 Description of the Titleholder

Woodside Energy Ltd (Woodside) is the operator and nominated titleholder of WA-28-L, including the associated infrastructure of the Greater Enfield Project (Australia Oil) Joint Venture, on behalf of itself and joint venture participant Mitsui E & P Australia Pty Ltd. Woodside's mission is to deliver superior shareholder returns through realising its vision of becoming a global leader in upstream oil and gas. Wherever Woodside works, it is committed to living its values of integrity, respect, working sustainably, discipline, excellence and working together. Woodside's operations are characterised by strong safety and environmental performance in remote and challenging locations.

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

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

1.8 Details of Titleholder, Liaison Person, and Activity Contact

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

1.8.1 Titleholder

Woodside Energy Ltd
11 Mount Street, Perth, Western Australia
Telephone: 08 9348 4000
Fax: 08 9214 2777
ACN: 005 482 986
ABN: 63 005 482 986

1.8.2 Activity Contact

Gerard Ransom
Asset Manager, Australia Oil
11 Mount Street, Perth, Western Australia
Phone: 08 9348 4000
Fax Number: 08 9214 2777
gerard.ransom@woodside.com.au

1.8.3 Liaison Person

Daniel Clery
Corporate Affairs Manager
11 Mount Street, Perth, Western Australia
Phone: 08 9348 4000
Fax Number: 08 9214 2777
feedback@woodside.com.au

1.8.4 Arrangements for Notifying of Change

Should the titleholder, titleholder's nominated liaison person or the contact details for either change, NOPSEMA is to be notified of the change within two weeks or as soon as practicable.

1.9 Woodside Management System

The Woodside Management System (WMS) provides a structured framework of documentation to set common expectations governing how all employees and contractors at Woodside will work. Many of the standards presented in **Section 6** are drawn from the WMS documentation, which comprises four elements: Compass and Policies; Expectations; Processes and Procedures; and Guidelines 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 development of processes and procedures.
- **Processes and Procedures**. Processes identify the set of interrelated or interacting activities which transforms inputs into outputs, to systematically achieve a purpose or specific objective. Procedures specify what steps, by whom and when are required to carry out an activity or a process.
- **Guidelines**. Provide recommended practice and advice on how to perform the steps defined in Procedures, together with supporting information and associated tools. Guidelines provide advice on: how activities or tasks may be performed; information that may be taken into consideration; or, how to use tools and systems.

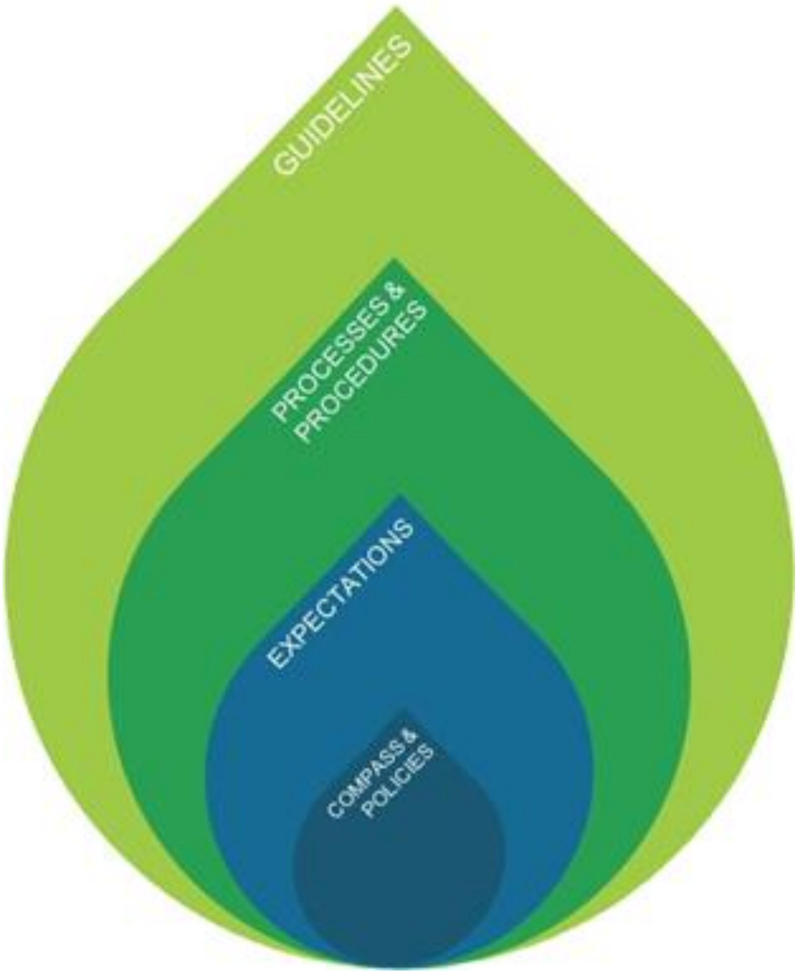


Figure 1-1: The four major elements of the WMS Seed

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 business activities are grouped into management, support and value stream activities as shown in **Figure 1-2**. The value stream activities capture, generate and deliver value – through the exploration and production lifecycle. The management activities influence all areas of the business, while support activities may influence one or more value stream activities.

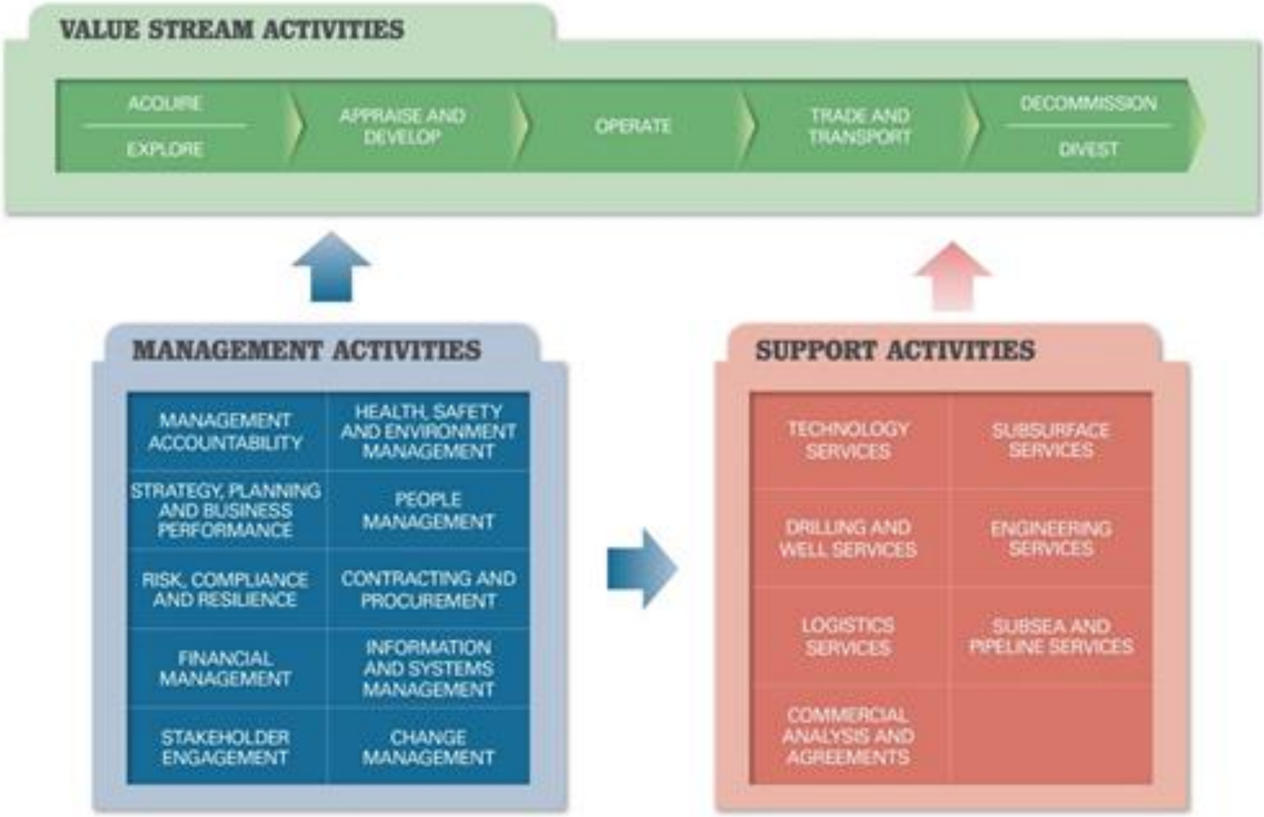


Figure 1-2: The WMS business process hierarchy

1.9.1 Health, Safety, Environment, and Quality Policy

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

1.10 Description of Relevant Requirements

In accordance with Regulation 13(4) of the Environment Regulations, a description of requirements, including legislative requirements, that apply to the activity and are relevant to managing risks and impacts of the Petroleum Activities Program, are detailed in **Appendix B**.

1.10.1 Applicable Environmental Legislation

1.10.1.1 Offshore Petroleum and Greenhouse Gas Storage Act 2006

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

The Environment Regulations apply to petroleum activities in Commonwealth waters, and are administered by NOPSEMA.

The objectives of the Environment Regulations include provisions to ensure petroleum activities are carried out in a manner:

- consistent with the principles of ecologically sustainable development
- by which the environmental impacts and risks of the activity will be reduced to ALARP
- by which the environmental impacts and risks of the activity will be of an acceptable level.

One of the final petroleum activities managed under the Environment Regulations for a petroleum title is decommissioning. Under subsection 270(3) of the OPGGS Act, before a title can be relinquished, all property brought into a title area must be removed or arrangements that are satisfactory to NOPSEMA must be made in relation to the property. The requirement for complete removal as a base case under the Act is also provided for in subsection 572(3). Subsection 572(2) provides that while structures, equipment and other property remain in the title area, they must be maintained in good condition and repair. Alternative arrangements that may be satisfactory are ones that deliver equal or better environmental, safety and well integrity outcomes compared to complete removal, and that the approach chosen complies with all other legislative and regulatory requirements. This is outlined in the Offshore Petroleum Decommissioning Guideline (Department of Industry, Innovation and Science [DIIS], 2018).

Decommissioning also includes permanently plugging wells for abandonment. The timeframe of activities for permanently plugging of wells for abandonment is managed by the Well Operations Management Plan (WOMP), as required by the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011. NOPSEMA is responsible for administering the WOMP and approving well activities under Part 5 of these regulations.

This EP has been written to meet the requirements of the OPGGS Act by demonstrating Woodside's commitment to meeting the base case of complete removal of the RTM from the title area, or demonstrating alternative arrangements that result in equal or better outcomes. Decommissioning activities associated with other infrastructure within WA-28-P will be subject to the development of future approvals. **Table 3-3** outlines the timeframes for activities covered under the scope of this EP and activities that will be covered under future EPs. This EP also demonstrates the ongoing preservation, including infrastructure IMMR activities that will be undertaken in relation to the Enfield reservoir until it is decommissioned (**Section 3.5**). Note: The WA-28-L title also contains the Greater Enfield reservoir which is tied back to the Ngujima-Yin FPSO. This facility is managed under a separate operations EP to demonstrate these requirements under the OPGGS Act.

1.10.1.2 Environment Protection and Biodiversity Conservation Act 1999

As part of NOPSEMA's assessment of an EP under the Environment Regulations, it must be shown that the petroleum activity does not contravene the values and objectives set out for any sensitive feature of the environment proclaimed under the EPBC Act, including for Australian Marine Parks (AMPs) and World Heritage Properties (WHPs). The EPBC Act is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) (formerly the Department of the Environment and Energy (DoEE)). The EPBC Act protects matters of national environmental significance (MNES) across Australia and protects the environment in relation to actions on (or impacting upon) Commonwealth land or waters. When a person proposes to take an action that they believe may need approval under the EPBC Act, they must refer the proposal to the Commonwealth Minister for Environment.

Woodside referred the Nganhurra facility (Enfield – WA-271-P) development proposal under the EPBC Act in April 2001 (Referral Reference 2001/257). The activity was determined to be a 'controlled action' under the EPBC Act and set the level of assessment at 'Environmental Impact Statement' in June 2001. The development was approved with conditions in July 2003 (EPBC Approval 2001/257). Conditions in relation to the referral (EPBC 2001/257) that are considered to be relevant to this EP are provided in **Table 1-3**.

This EP meets the requirements of condition 3 in relation to the referral (EPBC 2001/257). As required by condition 3; this includes adequate insurance in relation to oil spills, as detailed by the financial assurance details of the EP submissions (as modified by condition 11 of the referral).

This EP, and any future EP(s), in relation to the decommissioning of the Nganhurra facility (including subsea infrastructure above the seabed), will meet the requirements of condition 5 of the referral (EPBC 2001/257) (as modified by condition 11 of the referral).

Table 1-3: Conditions from Enfield Full Field Development referral (EPBC 2001/257) relevant to Nganhurra operations cessation

Condition Number	Condition
3	The person taking the action must submit for the Minister's approval an oil spill contingency plan detailing the strategy to mitigate the environmental effects of any hydrocarbon spills. The plan must include details of the insurance arrangements that the person taking the action has made or will make in respect of the costs associated with repairing any environmental damage arising from potential hydrocarbon spills. Operations may not commence until the plan is approved. The approved plan must be implemented.
5	The person taking the action must submit a decommissioning plan (or plans) for approval by the Minister one year prior to decommissioning any subsea wells, flowlines, or any associated infrastructure. The plan (or plans) must consider the complete removal of all structures and components above the sea floor. The approved plan must be implemented.
11	A plan required by condition 1, 2, 3, 4, 5 or 8 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that: a) was submitted to NOPSEMA after 27 February 2014; and b) either: i. is in force under the OPGGS Environment Regulations; or ii. has ended in accordance with regulation 25A of the OPGGS Environment Regulations.

Recovery Plans and Threat Abatement Plans

Under s139(1)(b) of the EPBC Act, the Minister must not act inconsistently with a recovery plan or threat abatement plan. 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 respect to offshore petroleum activities in Commonwealth waters, these requirements are implemented by NOPSEMA via the commitments included in the *Streamlining Offshore Petroleum Environmental Approvals Program*. These commitments relating to listed threatened species and ecological communities are included in the Program Report:

- NOPSEMA will not accept an Environment Plan that proposes activities that will result in unacceptable impacts to a listed threatened species or ecological community.
- NOPSEMA will not accept an Environment Plan that is inconsistent with a recovery plan or threat abatement plan for a listed threatened species or ecological community.
- NOPSEMA will have regard to any approved conservation advice in relation to a threatened species or ecological community before accepting an Environment Plan.

1.10.1.3 Environmental Protection (Sea Dumping) Act 1981

The Sea Dumping Act is the legislative instrument that addresses Australia's obligations under the London Protocol. The aims of the London Protocol are to protect and preserve the marine environment from all sources of pollution, and to prevent, reduce and eliminate pollution by controlling the dumping of wastes and other materials at sea. The Sea Dumping Act regulates the dumping at sea of controlled material (including certain wastes and other matter), the incineration at sea of controlled material, loading for the purpose of dumping or incineration, export for the purpose of dumping or incineration, and the placement of artificial reefs. Permits are required for any these activities.

The Sea Dumping Act and associated permits are administered by DAWE. Recfishwest has prepared and submitted to DAWE (September 2020) an artificial reef permit application to enable the assessment of the need for, and potential environmental impacts of, a proposal to place an IAR at sea. Woodside is liaising with Recfishwest regarding the requirements under the Sea Dumping Act for the proposed activities described in this EP (**Section 5**).

Currently the RTM is owned by Woodside. Ownership of the RTM will transfer to Recfishwest at an agreed time prior to commencing IAR installation. Following IAR installation and completion of a site survey, ownership of the IAR (including RTM), will transfer to the WA State Government through an agreement between Recfishwest and DPIRD, as per the DPIRD Policy on Habitat Enhancement Structures in Western Australia. As Recfishwest is the permit applicant, they will become responsible for the long-term monitoring and maintenance of the artificial reef once successfully installed at the IAR site (**Section 7.5.4**).

1.10.1.4 Australian Marine Parks

Under the EPBC Act, 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 Marine Parks (DNP) is responsible for managing AMPs (supported by Parks Australia), and is required to publish management plans for them. Other parts of the Australian Government must not perform functions or exercise powers in relation to these parks that are inconsistent with management plans (s.362 of the EPBC Act). Relevant AMPs are described in **Section 4.6**. The North-west Marine Parks Network Management Plan describes the requirements for management (DoEE, 2018a).

- Specific zones within AMPs have been allocated conservation objectives in the North-west Marine Parks Network Management Plan (DoEE, 2018a)) which are based on the Australian (International Union for Conservation of Nature (IUCN) reserve management principles prescribed in Schedule 8 of the *EPBC Regulations 2000*. Management objectives for each zone include: Special Purpose Zone (IUCN category VI)—managed to allow specific activities though special purpose management arrangements while conserving ecosystems, habitats and native species. The zone allows or prohibits specific activities.
- Sanctuary Zone (IUCN category Ia)—managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible. The zone allows only authorised scientific research and monitoring.
- National Park Zone (IUCN category II)—managed to protect and conserve ecosystems, habitats and native species in as natural a state as possible. The zone only allows non-extractive activities unless authorised for research and monitoring.
- Recreational Use Zone (IUCN category IV)—managed to allow recreational use, while conserving ecosystems, habitats and native species in as natural a state as possible. The zone allows for recreational fishing, but not commercial fishing.
- Habitat Protection Zone (IUCN category IV)—managed to allow activities that do not harm or cause destruction to seafloor habitats, while conserving ecosystems, habitats and native species in as natural a state as possible.
- Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park values.

1.10.1.5 World Heritage Properties

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

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

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

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

2 ENVIRONMENT PLAN PROCESS

2.1 Overview

This section outlines the process that Woodside undertake to prepare the EP once an activity has been defined as a petroleum activity (refer **Section 1.2**). The process (**Section 2.3**) describes the environmental risk management methodology that is used to identify, analyse and evaluate risks to meet ALARP and acceptability requirements and develop EPOs and EPSs. This section also describes Woodside's risk management methodologies applicable to implementation strategies applied during the activity.

Regulation 13(5) of the Environment Regulations requires the detailing of environmental impacts and risks, and evaluation appropriate to the nature and scale of each impact and risk associated with the Petroleum Activities Program. The objective of the risk 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 determine if the impact or risk level is acceptable.

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

- planned activities (routine and non-routine) have the potential for inherent environmental impacts
- an environmental risk is an unplanned event with the potential for impact (termed risk 'consequence').

Herein, potential impact from planned activities are termed 'impacts', and 'risks' are associated with unplanned events with the potential for impact (should the risk be realised), with such impact termed potential 'consequence'.

2.2 Environmental Risk Management Methodology

2.2.1 Woodside Risk Management Processes

Woodside recognises that risk is inherent to its business and that effectively managing risk is vital to delivering on company objectives, success and continued growth. Woodside is committed to managing all risks 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 the following key areas of exposure: health and safety, environment, finance, reputation and brand, legal and compliance, and social and cultural. A copy of Woodside's Risk Management Policy is provided in **Appendix A**.

The environmental risk management methodology used in this EP is based on Woodside's Risk Management Procedure. This procedure aligns to industry standards such as international standard ISO 31000:2009. The WMS risk management procedure, guidelines and tools provide guidance on specific techniques for managing risk, tailored for particular areas of risk within certain business processes. Three such procedures applied for environmental risk management include Woodside's:

1. Health Safety and Environment Management Procedure
2. Impact Assessment Procedure
3. Process Safety Management Procedure.

The risk management methodology provides a framework to demonstrate that the risks and impacts are continually identified, reduced to ALARP and assessed to be at an acceptable level, as required by the Environment Regulations. The key steps of Woodside's Risk Management Process are shown in **Figure 2-1**. A description of each step and how it is applied to the scopes of this activity is provided in **Sections 2.1** to **2.10**.

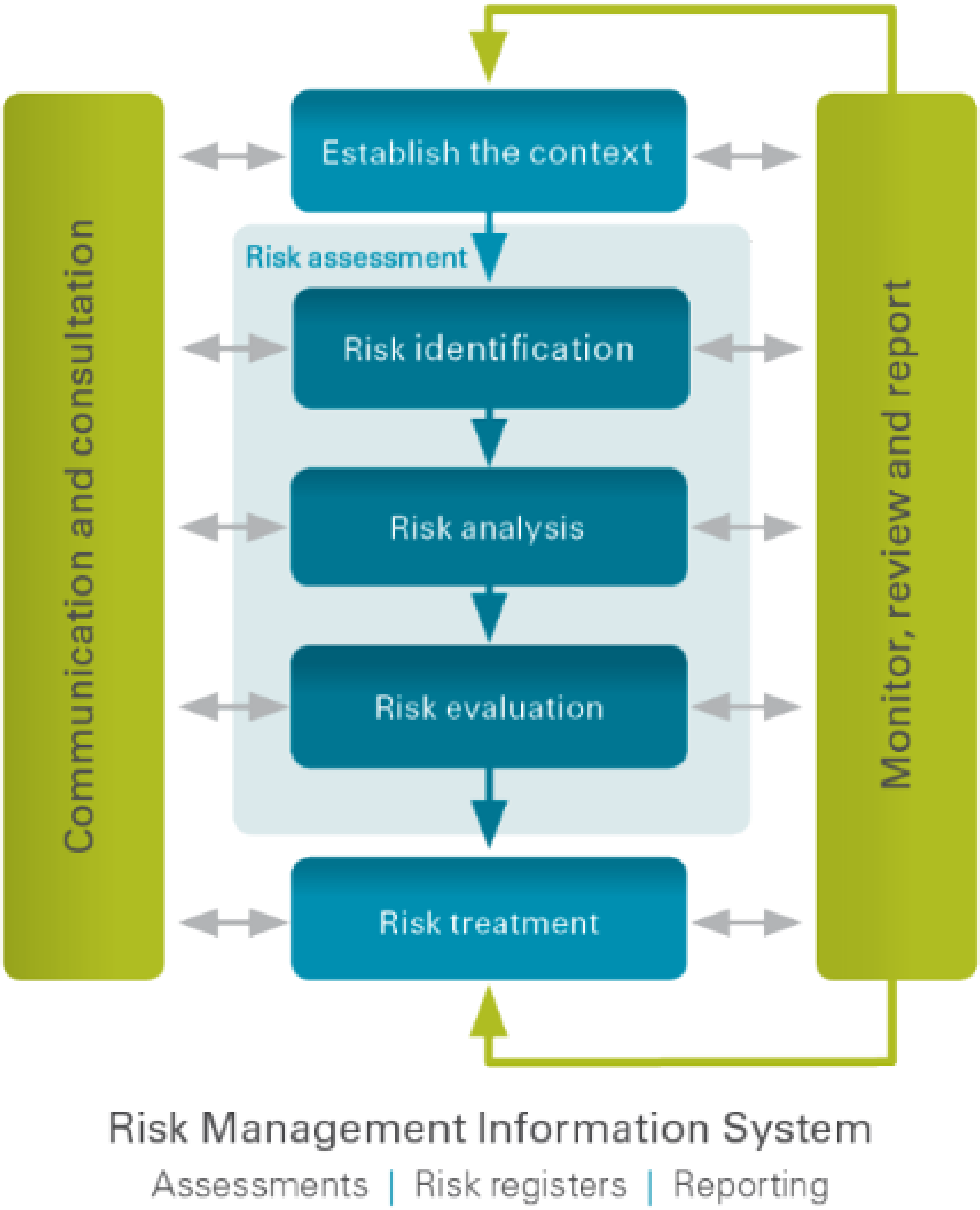


Figure 2-1: Woodside's risk management process

2.2.2 Health, Safety, and Environment Management Procedure

Woodside's Health, Safety, and Environment Management Procedure provides the structure for managing health, safety, and environment (HSE) risks and impacts across Woodside and defines the decision authorities for company-wide HSE management activities and deliverables, and to support 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 needed to meet required environment, health and social standards by ensuring impacts are assessed appropriate to the nature and scale of the activity, the regulatory context, the receiving environment, interests, concerns and rights of stakeholders, and the applicable framework of standards and practices.

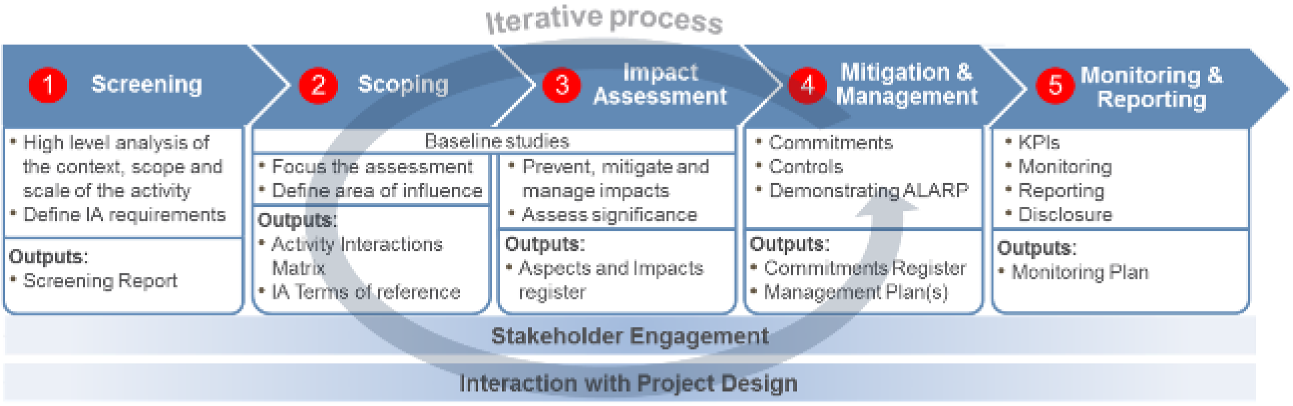


Figure 2-2: Woodside's impact assessment process

2.3 Environmental Plan Process

Figure 2-3 illustrates the Environment Plan development process. Each element of this process is discussed further in **Sections 2.4** to **2.10**.

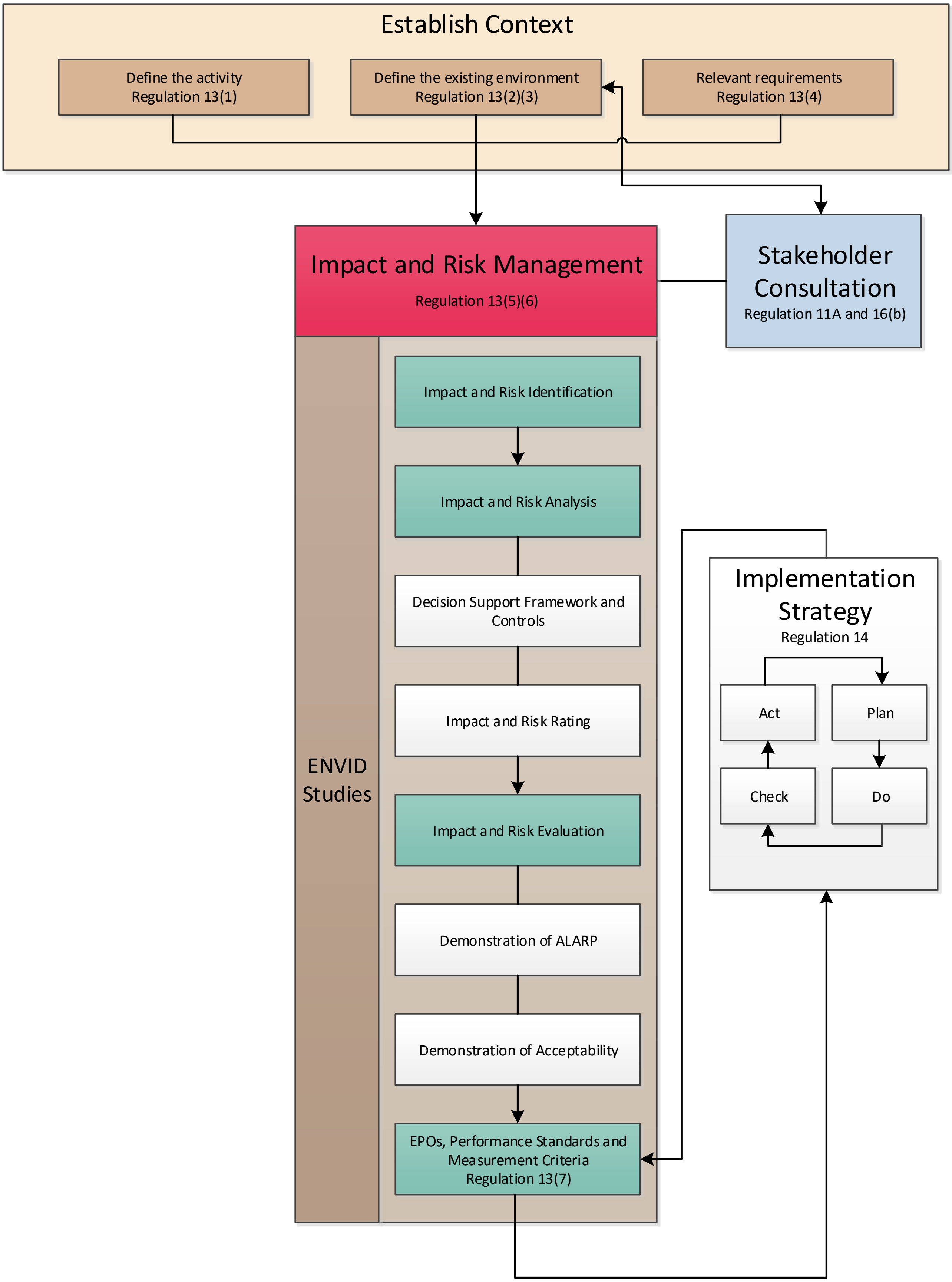


Figure 2-3: Environment plan development process

2.4 Establish the Context

2.4.1 Define the Activity

This first stage involves evaluating whether the activity meets the definition of a 'petroleum activity' as defined in the Environment Regulations.

The activity is then 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 referred to as the Petroleum Activities Program.

2.4.2 Defining the Existing Environment

The existing environment that may be impacted by the Petroleum Activities Program (as described in **Section 4**) is defined by considering the nature and scale of the activities (i.e. size, type, timing, duration, complexity and intensity of the activities). The existing environment that may potentially be impacted directly or indirectly by planned and unplanned[2] events.

The Existing Environment section is structured to define 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 sub-sections make particular reference to the following:

- The environmental values potentially impacted by the Petroleum Activities Program, which include key physical and biological attributes of the existing environment (as defined by Woodside in **Table 2-1** and **Section 2.4.2**).
- EPBC Act Matters of National Environmental Significance (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 within the title area (planned events) and the Environment that May Be Affected (EMBA) of unplanned events[2]. Potential impacts to MNES as defined within the EPBC Act are addressed through Woodside's impact and risk assessment process (**Section 2.9**).
- Relevant values and sensitivities, which may include world or national heritage listed areas, Ramsar wetlands, listed threatened species or ecological communities, listed migratory species, and sensitive values that exist in or in relation to Commonwealth marine area or land.

In categorising the environmental values potentially impacted by the Petroleum Activities Program (as presented in **Table 2-1**), there is standardisation of information relevant to understanding the receiving environment. Potential impacts to these environmental values are evaluated in the risk analysis (refer **Section 2.6**), and risk-rated for all planned and unplanned activities. This provides a robust approach to the overall environmental risk evaluation and its documentation in the EP.

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

[2] 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 Environment that May Be Affected (EMBA) for the release, which defines the spatial scale of the environment that may be potentially impacted for the Petroleum Activities Program, which provides context to the 'nature and scale' of the existing environment.

Table 2-1: Environment values potentially impacted by the Petroleum Activities Program, which are assessed within the EP

Environmental Value Potentially Impacted Regulations 13(2)(3)						
Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (including Odour)*	*Ecosystems/ habitats*	*Species*	*Socio-economic*

The existing environment is described in **Section 4.**

2.4.3 Relevant Requirements

The relevant requirements in the context of legislation, other environmental approval requirements, condition and standards that apply to the Petroleum Activities Program have been identified and reviewed.

Relevant requirements are presented in **Appendix B**.

Woodside's Corporate Health Safety, Environment and Quality Policy is presented in **Appendix A**.

2.5 Impact and Risk Identification

Relevant environmental aspects and hazards have been identified to 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 environmental hazard identification studies (e.g. HAZID/ENVID), Process Safety Risk Assessment processes, reviews and associated desktop studies associated with the Petroleum Activities Program. Risks are 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' thereafter in this EP.

The ENVID has been performed by multidisciplinary teams consisting of relevant engineering and environmental personnel with sufficient breadth of knowledge, training and experience to reasonably assure that risks were identified and their potential environmental impacts assessed. Impacts and risks were identified during the ENVID for both planned (routine and non-routine) activities and unplanned (accidents/incidents/emergency conditions) events. During this process, risks that are identified as not applicable (not credible) are removed from the assessment. This is done by defining the activity and identifying that an aspect is not applicable.

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

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

Impacts and Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***					
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (including Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence/Impact***	***Likelihood***	***Risk Rating***	***ALARP Tools***	***Acceptability***
Summary of source of impact/risk													

2.6 Impact and Risk Analysis

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

The key steps performed for each risk identified during the risk assessment were:

1. identify the decision type in accordance with the decision support framework
2. identify appropriate control measures (preventative and mitigation) aligned with the decision type
3. assess the risk rating.

2.6.1 Decision Support Framework

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

- Activities do not pose an unacceptable environmental risk.
- Appropriate focus is placed on activities where the risk is anticipated to be acceptable and demonstrated to be ALARP.
- Appropriate effort is applied to manage the risks 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 (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, and documented in ENVID output.

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

2.6.1.1 Decision Type A

Risks classified as a Decision Type A are well understood and established practice. They generally consider recognised good industry practice which is often embodied in legislation, codes and standards and use professional judgement.

2.6.1.2 Decision Type B

Risks classified as a Decision Type B typically involve greater uncertainty and complexity. These risks may deviate from established practice or have some lifecycle implications and therefore require further engineering risk assessment in order 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

Risks classified as a Decision Type C typically have significant risks related to environmental performance. Such risks typically involve sufficient complexity and uncertainty, therefore requiring 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, in addition to Decision Type A and B tools, company and societal values need to be considered by undertaking broader internal and external stakeholder consultation as part of the risk assessment process.

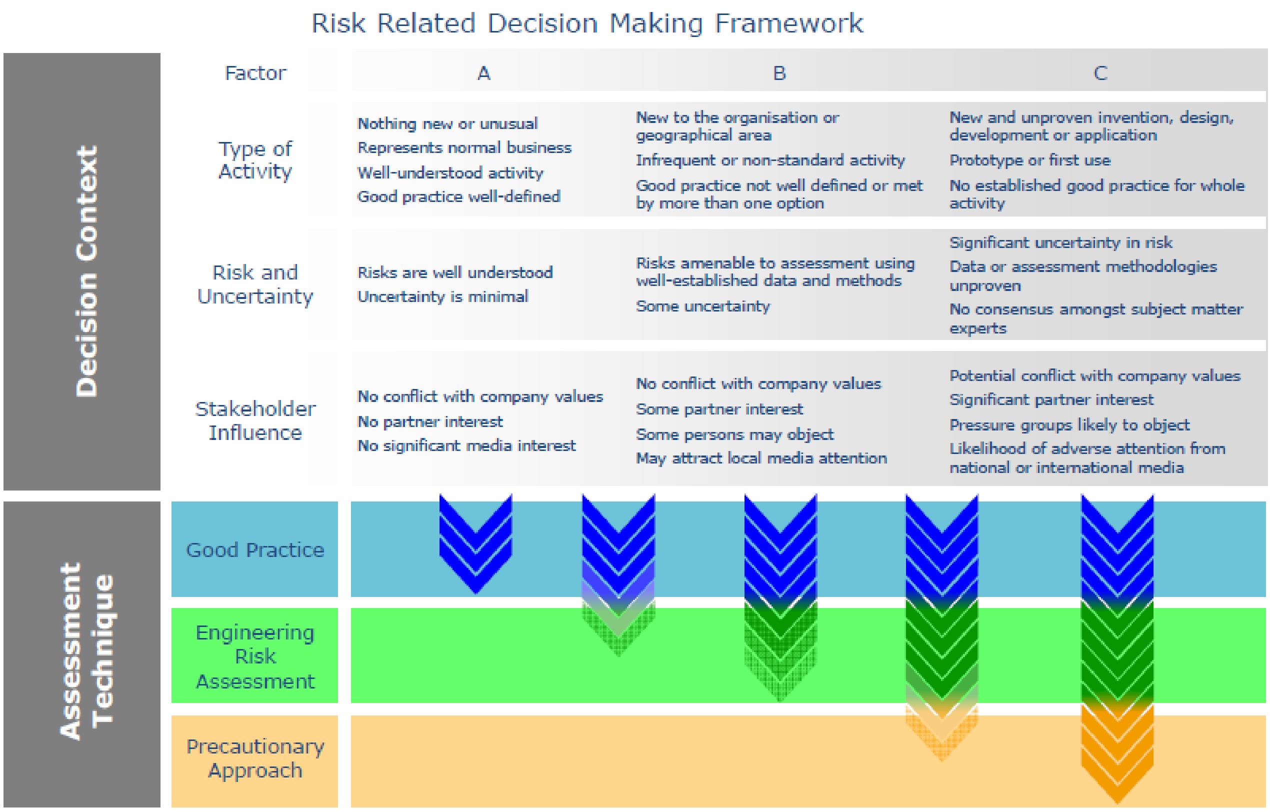


Figure 2-4: Risk-related decision-making framework

Source: Oil and Gas UK, 2014

2.6.1.4 Decision Support Framework Tools

The following framework tools are applied, as appropriate, to assist with identifying control measures based on the decision type described above:

- **Legislation, Codes and Standards (LCS)** – identifies the requirements of legislation, codes and standards which are to be complied with for the activity.
- **Good Industry Practice (GP)** – identifies further engineering control standards and guidelines which may be applied by Woodside above that required to meet the legislation, codes and standards.
- **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 or potential risk.
- **Societal Values (SV)** – identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder views, concerns and perceptions.

2.6.1.5 Decision Calibration

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

- **Legislation, Codes and Standards / Verification of Predictions** – Verification of compliance with applicable legislation, codes and standards and/or good industry practice.
- **Peer Review** – Independent peer review of professional judgements, supported by risk-based analysis, where appropriate.
- **Benchmarking –** where appropriate benchmark against a similar facility or activity type or situation which has been accepted 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 should be 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** which include design measures to prevent or reduce the frequency of the risk event, 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 should a hazardous event occur
- response equipment: design measures or safeguards that enable clean-up/response following the realisation of a hazardous event.

* **Procedures and Administration** which include management systems and work instructions used to prevent or mitigate environmental exposure to hazards.
* **Emergency Response and Contingency Planning** which includes methods to enable recovery from the impact of an event (e.g. protection barriers deployed near to the sensitive receptor).

2.6.3 Impact and Risk Classification

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

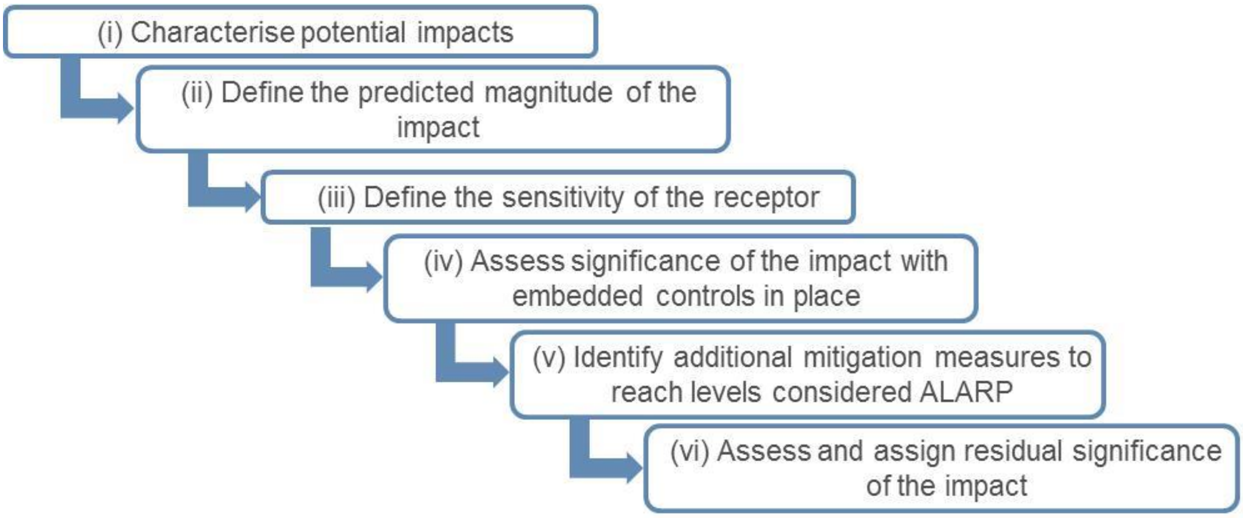


Figure 2-5: Environmental impact and risk analysis

Impacts are classified in accordance with the consequence (**Section 2.6.3**) outlined in the Woodside Risk Management Procedure and Risk Matrix.

Risks are assessed qualitatively and/or quantitatively in terms of both likelihood and consequence in accordance with the Woodside Risk Management Procedure and Risk Matrix.

The impact and risk information is summarised, including classification, and evaluation information, as shown in the example in **Table 2-3**, evaluated 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 ecosystems, species, habitat or physical or biological attributes	Catastrophic, long-term impact (>20 years) to a community, social infrastructure or highly valued areas/items of international cultural significance	*A*
Major, long-term impact (10–50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	Major, long-term impact (5–20 years) to a community, social infrastructure or highly valued areas/items of national cultural significance	*B*

Environment	Social and Cultural	Consequence Level
Moderate, medium-term impact (2–10 years) on ecosystems, species, habitat or physical or biological attributes	Moderate, medium-term Impact (2–5 years) to a community, social infrastructure or highly valued areas/items of national cultural significance	*C*
Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystem's function), physical or biological attributes	Minor, short-term impact (1–2 years) to a community or highly valued areas/items of cultural significance	*D*
Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem's function), physical or biological attributes	Slight, short-term impact (<1 year) to a community or areas/items of cultural significance	*E*
No lasting effect (<1 month); localised impact not significant to environmental receptors	No lasting effect (<1 month); localised impact not significant to areas/items of cultural significance	*F*

2.6.3.1 Risk Rating Process

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

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

Select the Consequence Level

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

Select the Likelihood Level

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

Table 2-4: Woodside risk matrix likelihood levels

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

Calculate the Risk Rating

The risk level is derived from the consequence and likelihood levels determined above in accordance with the risk matrix shown in **Figure 2-6**. A likelihood and risk rating is only applied to environmental risks using the Woodside risk matrix.

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

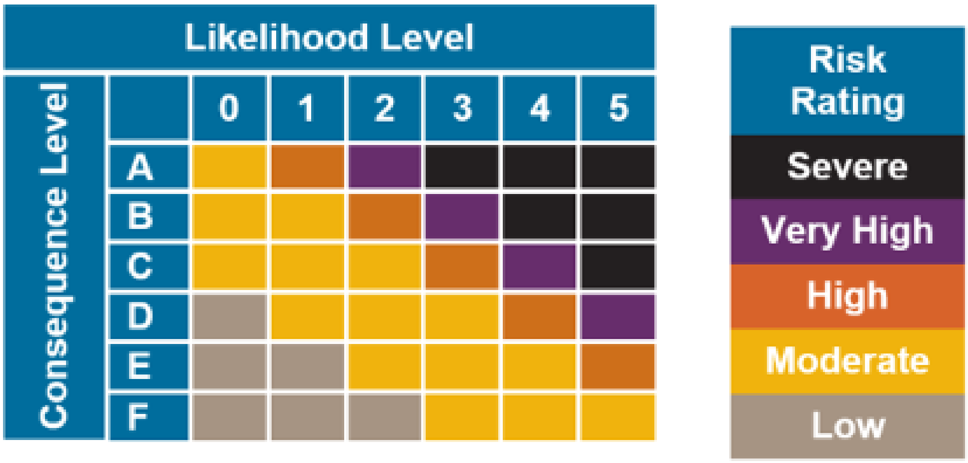


Figure 2-6: Woodside risk matrix: risk level

In support of ongoing risk management (a key component of Woodside's Process Safety Management Framework [**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 the controls that are currently in place and regularly effective. 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 the communication and visibility of the risk events, and ensure risk is continually managed to ALARP by identifying risk reduction measures and assessing acceptability.

2.7 Impact and Risk Evaluation

Environmental impacts and risks cover a wide range of issues affected by differing species, persistence, reversibility, resilience, cumulative effects and variability in severity. Determining the degree of environmental risk and the corresponding threshold for whether an impact or risk has been reduced to ALARP and is acceptable, is evaluated to a level appropriate to the nature and scale of each impact or risk. The evaluation considers:

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

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

2.7.1 Demonstration of ALARP

Descriptions have been provided in **Table 2-5** to articulate how Woodside demonstrates 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	***Negligible, Slight, or Minor (D, E or F)***	***A***
Woodside demonstrates these risks, impacts and decision types are reduced to ALARP if: • controls identified meet legislative requirements, industry codes and standards, applicable company requirements and industry guidelines • further effort towards impact/risk reduction (beyond employing opportunistic measures) is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.		
High, Very High or Severe	***Moderate and above (A, B or C)***	***B and C***
Woodside demonstrates these higher order risks, impacts and decision types are reduced to ALARP (where it can be demonstrated using good industry practice and risk-based analysis) that: • legislative requirements, applicable company requirements and industry codes and standards are met • societal concerns are accounted for • the alternative control measures are grossly disproportionate to the benefit gained.		

2.7.2 Demonstration of Acceptability

Descriptions have been provided in **Table 2-6** to articulate how Woodside demonstrates that different risks, impacts and Decision Types identified within the EP are acceptable. (Please also refer to **Figure 2-7** for a visual representation against Woodside's risk matrix).

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 employing opportunistic measures) is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.		
High, Very High or Severe	***Moderate and above (A, B or C)***	***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 current 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**) • other requirements – the proposed controls and consequence/risk level are consistent with national and international industry standards, laws and policies and consideration of applicable plans for management and conservation advice, conventions, and significant impact guidelines (e.g. for MNES). Additionally, Very High and Severe risks require 'Escalated Investigation' and mitigation to reduce the risk to a lower and more acceptable level. If after further investigation the risk remains in the Very High or Severe category, the risk requires appropriate business engagement in accordance with Woodside's Risk Management Procedure to accept the risk. This includes due consideration of regulatory requirements.		

Figure 2-7: Environmental risk evaluation

2.7.3 Recovery Plan and Threat Abatement Plan Assessment

To support the demonstration of acceptability, a separate process is undertaken to demonstrate that the EP is consistent with any relevant recovery plans or threat abatement plans (refer **Section 1.10.1.2**). The steps in this process are:

- Identify relevant listed threatened species and ecological communities (**Section 4**).
- Identify relevant recovery plans and threat abatement plans (**Section 4**).
- 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**).
- 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 inconsistent with that action (**Section 6**).

2.8 Environmental Performance Objectives/Outcomes, Standards and Measurement Criteria

EPOs/EPSs and measurement criteria have been defined to address the potential environmental impacts and risks and are presented in **Section 6**.

2.9 Implementation, Monitoring, Review, and Reporting

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

- Control measures are effective in reducing the environmental impacts and risks of the Petroleum Activity Program to ALARP and acceptable levels.
- Environmental performance outcomes and standards set out in the EP are met, through monitoring, recording, audit, management of non-conformance and review.
- All environmental impacts and risks of the Petroleum Activity Program are continually identified and reduced to ALARP and acceptable levels.

- Roles and responsibilities are clearly defined, and personnel are competent and appropriately trained to implement the EP, including in emergencies or potential emergencies.
- Arrangements are in place for oil pollution emergencies to respond to, and monitor impacts.
- Environmental reporting requirements, including 'reportable incidents', are met.
- Appropriate stakeholder consultation is undertaken throughout the activity.

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

2.10 Stakeholder Consultation

A stakeholder assessment is performed to identify relevant persons (as defined under Regulation 11A of the Environment Regulations) to whom an activity update is issued electronically to provide a reasonable consultation period. Further details and information is provided to any stakeholder if requested.

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

The stakeholder consultation, along with the process for ongoing engagement and consultation throughout the activity, is presented in **Section 5.**

3 DESCRIPTION OF THE ACTIVITY

3.1 Overview

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

3.2 Project Overview

The Enfield reservoir has reached the end of its economic production life. Options and timing for cessation of operations were developed, in line with Woodside strategy and regulatory requirements, to allow for the Nganhurra FPSO to be removed from the field following cessation of production.

Initial cessation of operations activities were undertaken in the Enfield field between November 2018 and March 2019, as described under Revision 2 of this EP. The activities that have already been completed, and thus removed from the EP include:

- disconnection of FPSO and sail away from Operational Area 1
- isolation of wells at the flow base
- flushing and preservation of the subsea system
- disconnection of risers/electro-hydraulic umbilical (EHU) and removal of buoyancy modules
- re-lay risers/electro-hydraulic umbilical on seabed until final decommissioning.

The RTM was planned to be removed as part of these activities; however, during the initial cessation of operations activities, it was determined that the RTM could not be ballasted to horizontal as originally planned. Revision 2 of this EP has been revised to cover the change in disposal plan for the RTM. The options assessed and the IAR option selected are presented in **Section 3.6**. The assessment of the need for, and potential environmental impacts of, a proposal to place an IAR at sea is being sought by Recfishwest, through a permit for the proposed placement under Section 19 of the Sea Dumping Act. The towing and placement of the RTM and purpose-built reef structures to form an IAR will be undertaken in accordance with the artificial reef permit. Towing the RTM outside WA-28-L and installing it on the seabed as an IAR have been included as part of the revised Petroleum Activities Program.

The remaining activities covered under this revised EP in preparation for future decommissioning are listed in **Section 1.2**.

There is no well integrity driver for immediate intervention of any wells. Any intervention activities that may be undertaken would be opportunistic, to set up for a more cost effective and efficient abandonment program at a later time. For example, intervention to set additional barriers such as deep set temporary plugs may open up subsequent permanent abandonment of wells to a wider range of vessels/rigs.

Woodside is currently planning for the permanent plugging for abandonment of the wells, which along with decommissioning related scopes, will be the subject of separate EP(s) and is beyond the scope of this EP. Timing for these is described in **Section 3.4**.

An overview of the Petroleum Activities Program is provided in **Table 3-1**.

Table 3-1: Petroleum Activities Program overview

Item	Description
Title area	WA-28-L
Location	Exmouth Sub-basin
Water depth	• Operational Area 1: ~400–600 m • Operational Area 2: ~130–400 m (depth at proposed IAR location is 150 m on average).
Number of wells	• eight production wells • eight water injection wells • two gas injection wells.
Subsea infrastructure	• four production manifolds (EDC1, EDC2, EDC3 and EDC5) • 18 subsea Xmas trees • two 9-inch production flowlines and risers • one 8-inch production test flowline and riser • one 10-inch water re-injection flowline and riser • one 6-inch gas injection flowline and riser • one 6-inch gas lift flowline and riser.
Vessels	• primary installation vessel (PIV) for RTM removal and placing and installing reef structures to augment the RTM as an IAR • intervention vessel for well intervention activities • support vessels including anchor handling tug(s) (AHT) for RTM towing and general supply/support.
MODU	• semi-submersible moored MODU or dynamically positioned (DP) MODU, depending on availability.
Key activities	• IMMR activities on the RTM while it remains on station • disconnection of mooring lines from RTM and lay lines on seabed • removal of RTM from field • towing RTM to proposed IAR site and undertaking stabilisation and augmentation as an IAR • IMMR activities on subsea infrastructure including wells • opportunistic well interventions.

3.3 Location

The Petroleum Activities Program is located in Commonwealth waters in the Exmouth Sub-basin. WA-28-L is about 38 km north of North West Cape (WA)Australia, and about 2 km east of the Enfield field. The proposed IAR site is about 16 km north of North West Cape within a vacant petroleum title. The location coordinates, water depth, dimensions and status of the Petroleum Activities Program infrastructure are presented in **Table 3-2**. The layout of the Enfield field are presented in **Figure 3-1**. The layout of the proposed IAR is presented in **Figure 3-13**.

Table 3-2: RTM and subsea infrastructure coordinates, depth, dimensions, and status

Structure	Latitude	Longitude	Water Depth (m)	Dimensions	Connection		Status[1]
					Start	End	
Riser Turret Mooring							
RTM	21° 28' 53.268" S	114° 00' 29.249" E	396	85 m long (~94 m including riser tails) 4.5–12.5 m diameter	Not applicable (N/A)	N/A	No longer active
Anchor Chains 1–9	Anchor location: 1. 21° 28' 25.28" S 2. 21° 28' 26.93" S 3. 21° 28' 26.43" S 4. 21° 29' 07.62" S 5. 21° 29' 09.48" S 6. 21° 29' 11.50" S 7. 21° 29' 07.18" S 8. 21° 29' 04.96" S 9. 21° 29' 02.73" S	Anchor location: 1. 114° 00' 29.85" E 2. 114° 00' 32.33" E 3. 114° 00' 34.18" E 4. 114° 00' 54.73" E 5. 114° 00' 53.18" E 6. 114° 00' 51.56" E 7. 114° 00' 02.58" E 8. 114° 00' 01.19" E 9. 114° 00' 00.11" E	1. 405 2. 402 3. 399 4. 364 5. 364 6. 365 7. 424 8. 426 9. 429	Length: 1. ~1 km 2. ~1 km 3. ~1 km 4. ~1 km 5. ~1 km 6. ~1 km 7. ~1 km 8. ~1 km 9. ~1 km	Anchors 1–9	RTM	Active
Proposed Integrated Artificial Reef (IAR) Site							
Centre of IAR	21° 39' 30" S	114° 04' 40" E	150	Up to 300 m × 300 m within 500 m radius of centrepoint	See tow route for RTM below		N/A
Proposed RTM Tow Route to IAR Site							
RTM	Points along tow route where heading changes: 1. 21° 30' 20" S 2. 21° 32' 0" S 3. 21° 35' 48" S	Points along tow route where heading changes: 1. 114° 0' 29" E 2. 113° 58' 54" E 3. 113° 58' 54" E	1. 366 2. 383 3. 270	85 m long 4.5–12.5 m diameter	RTM	Centre of IAR	N/A
Subsea Wells with Xmas Trees							
Production Well ENA01	21° 28' 54.064" S	113° 59' 21.678" E	513	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Well ENA02	21° 28' 53.564" S	113° 59' 21.236" E	513	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active

Structure	Latitude	Longitude	Water Depth (m)	Dimensions	Connection		Status[1]
					Start	End	
Production Well ENA03	21° 28' 54.289" S	113° 59' 20.402" E	515	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Well ENA04	21° 28' 55.221" S	113° 59' 21.573" E	513	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Well ENA05	21° 28' 54.803" S	113° 59' 21.012" E	513	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Well ENE01	21° 28' 53.335" S	113° 59' 17.083" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Well ENE02	21° 28' 53.958" S	113° 59' 17.693" E	520	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Well ENE03	21° 28' 52.842" S	113° 59' 17.851" E	520	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENB01	21° 27' 55.752" S	113° 59' 34.297" E	495	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENB02	21° 27' 55.337" S	113° 59' 34.719" E	495	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENB03	21° 27' 56.005" S	113° 59' 35.450" E	495	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENC01	21° 29' 14.814" S	113° 58' 30.698" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENC02	21° 29' 15.281" S	113° 58' 30.267" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENC03	21° 29' 15.457" S	113° 58' 31.396" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENC04	21° 29' 14.920" S	113° 58' 30.020" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Water Injection Well ENC05	21° 29' 15.920" S	113° 58' 31.392" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active

Structure	Latitude	Longitude	Water Depth (m)	Dimensions	Connection		Status[1]
					Start	End	
Gas Injection Well END01	21° 30' 3.582" S	113° 57' 51.152" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Gas Injection Well END02	21° 30' 3.853" S	113° 57' 50.826" E	550	~5.8 m tall 4 m wide 6.8 m long	N/A	N/A	Shut in. No longer active
Production Manifolds							
EDC1	21° 28' 54.19"S	113° 59' 21.19"E	516	~5.5 m tall 8.5 m wide 8.5 m long	N/A	N/A	No longer active
EDC2	21° 27' 55.88" S	113° 59' 34.84" E	494	~5.5 m tall 8.5 m wide 8.5 m long	N/A	N/A	No longer active
EDC3	21° 29' 15.35" S	113° 58' 30.82" E	550	~5.5 m tall 8.5 m wide 8.5 m long	N/A	N/A	No longer active
EDC5	21° 28' 53.42" S	113° 59' 17.78" E	522	~5.5 m tall 8.5 m wide 8.5 m long	N/A	N/A	No longer active
Flowlines and Risers							
Production flowline with riser 1	See Start / End			9-inch diameter ~2.3 km long	EDC05 via EDC01	RTM[2]	No longer active
Production flowline with riser 2	See Start / End			9-inch diameter ~2.2 km long	EDC05 via EDC01	RTM[2]	No longer active
Production test flowline with riser	See Start / End			8-inch diameter ~2.2 km long	EDC05 via EDC01	RTM[2]	No longer active
Water re-injection flowline with riser	See Start / End			10-inch diameter ~3.0 km long	EDC02	RTM[2]	No longer active
Water re-injection flowline with riser	See Start / End			10-inch diameter ~3.5 km long	EDC03	EDC02	No longer active
Gas injection flowline with riser	See Start / End			6-inch diameter ~5 km long	END01	RTM[2]	No longer active
Gas lift flowline with riser	See Start / End			6-inch diameter ~3.9 km long	EDC05 via EDC01	RTM[2]	No longer active

Structure	Latitude	Longitude	Water Depth (m)	Dimensions	Connection		Status[1]
					Start	End	
Electro-hydraulic Umbilical							
EHU	See Start / End			~2.2 km long	EDC01	RTM[2]	No longer active
EHU	See Start / End			~2.2 km long	EDC02	EDC01	No longer active
EHU	See Start / End			~2.3 km long	EDC05	EDC01	No longer active
EHU	See Start / End			~1.8 km long	EDC03	EDC01	No longer active
EHU	See Start / End			~2.0 km long	END01	EDC03	No longer active

[1] Status at time of submission of this EP (Revision 6)
[2] No longer connected

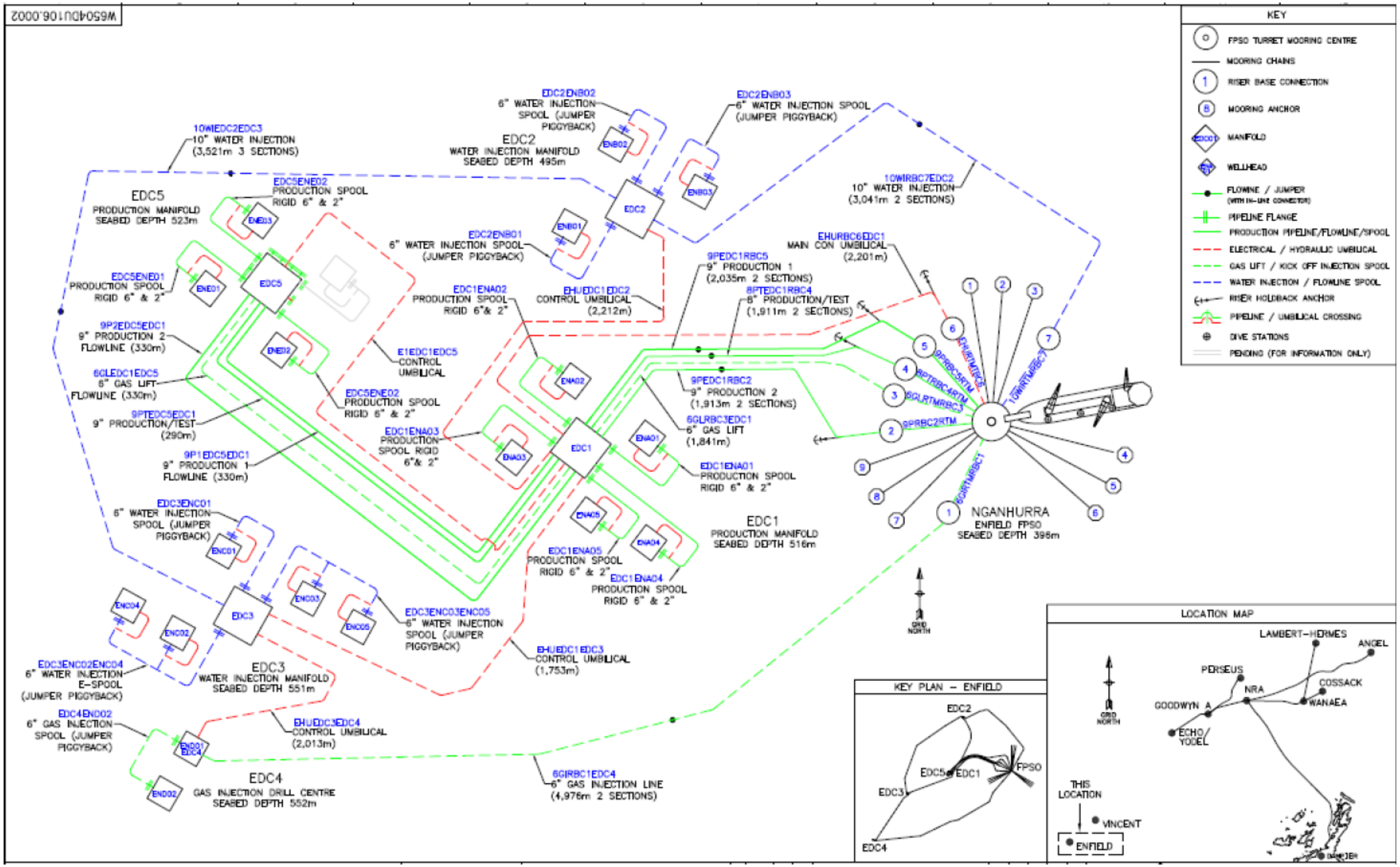


Figure 3-1: Enfield field schematic

3.3.1 Operational Areas

The Operational Area defines the spatial boundary of the Petroleum Activities Program, as described, risk assessed and managed by this EP, including MODU/vessel-related petroleum activities. For this EP, two Operational Areas have been defined to allow impacts and risks to be evaluated separately for activities conducted within WA-28-L and activities associated with towing, installation on the seabed, stabilisation and modification of the RTM on the seabed, and placement of reef modules to form an IAR. The activities of towing the RTM outside of WA-28-L and installing it o the seabed as an IAR have been included as part of the Petroluem Activity Program on the basis that these constitute impacts and risks associated with the petroleum activity. The Operational Areas (**Figure 3-2**) are representative of the combined delineated distances from the greater of the following:

- Operational Area 1 (activities within WA-28-L):
  - 1500 m radius around the RTM to allow for IMMR activities and for the disconnected anchor chains to be laid on the seabed
  - 4000 m radius around all wells to allow a moored MODU to undertake well intervention-related petroleum activities
  - 500 m area around flowlines to allow subsea IMMR activities to be undertaken.
- Operational Area 2 (impacts and risks from the towing, placement, stabilisation and augmentation of RTM as an IAR):
  - 2000 m buffer either side the proposed tow route of the RTM from its current location within WA-28-L to the proposed IAR site, except where this comes close to the Ningaloo WHP and AMP
  - 280 m Ningaloo proximity buffer (including 100 m no-go zone) to ensure no activities occur within the Ningaloo WHP and AMP
  - 500 m radius surrounding the proposed IAR centre point, within which all structures associated with the IAR will be placed.

There is a 500 m petroleum safety zone around the RTM. This will remain in place until the RTM is removed from Operational Area 1. The Operational Area for intervention activities (part of Operational Area 1) includes a 500 m petroleum safety zone around the intervention vessel or MODU to allow for and manage vessel movements. A temporary 500 m operational safety zone will be in place during towing, placement, stabilisation, and modification of the RTM as an IAR, as well as installation of the reef modules.

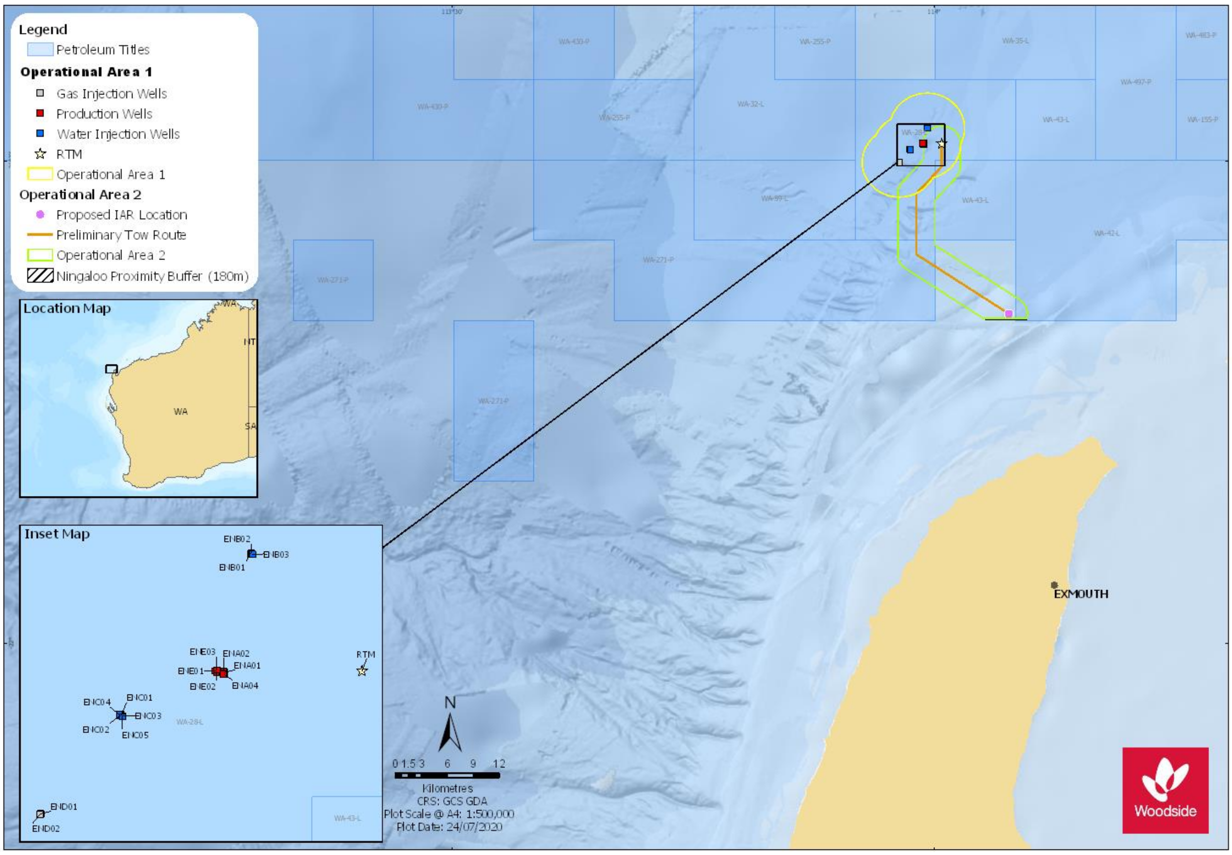


Figure 3-2: Petroleum Activities Program Operational Areas

3.4 Timing

The Petroleum Activities Program commenced in Q4 2018 under Revision 2 of this EP, which was accepted by NOPSEMA in December 2017 and has a five-year duration (expiring December 2022). The duration for this EP (Revision 6) includes an additional year of preservation to allow future decommissioning approvals to be prepared (**Table 3-3**). The inspection and preservation of the subsea systems and RTM is ongoing until the RTM is removed from the field, the wells are permanently plugged for abandonment, and final decommissioning of the field commences. **Table 3-3** outlines the timing for activities that comprise the Petroleum Activities Program of this revised EP (**Section 1.2**), as well as for future decommissioning activities related to WA-28-L**.**

When underway, activities covered under this EP will be carried out 24 hours per day, seven days per week. Concurrent well intervention activities may occur under the EP, based on operational synergies with an intervention vessel and a MODU. The schedule and timeframe presented in **Table 3-3** may be subject to change due to operational requirements and external influences such as contract awards, availability of vessels, MODU, equipment, and materials, and/or metocean conditions.

Table 3-3: Indicative timing of Petroleum Activities Program and future decommissioning activities associated with WA-28-L

Activity	Indicative Timing	Duration (Cumulative Duration)	Comment
Petroleum Activities Program (activities covered under this EP)			
RTM removal	Anticipated between December 2020 and end April 2021[1]	Planned duration of ~30 days (up to 90 days) in WA-28-L title area.	RTM removal delayed following initial cessation activities until new disposal option determined and all appropriate approvals in place (**Section 3.6**).
RTM tow to IAR site	Anticipated between December 2020 and end April 2021[3]	Planned duration of ~6–12 hours	Will be undertaken in accordance with Recfishwest's accepted artificial reef permit application (currently under assessment by DAWE).
Placement, stabilisation and modification of RTM and installation of reef modules to create an IAR	Anticipated between December 2020 and end April 2021[3]	Planned duration of ~15–20 days	Will be undertaken in accordance with Recfishwest's accepted artificial reef permit application (currently under assessment by DAWE).
RTM and subsea IMMR Activities	Ongoing until RTM removal, permanent plugging for well abandonment and subsea decommissioning (refer to **Table 3-22**).	Ongoing	IMMR activities on the RTM undertaken to minimise risk or the RTM sinking and ensure RTM can be removed. The subsea system preservation period will extend until wells are abandoned and remaining subsea infrastructure is decommissioned.
Well intervention	Opportunistically during 2021–2022.	Planned duration of ~10–20 days per well is expected (up to 18 months for all wells)	All 18 wells may be intervened (as required)
Future Decomissioning Activities (subject to future EP and not included in scope of this EP)			
Permanent plugging of wells for abandonment	Anticipated to commence in 2022[2] (planned EP submission date: 2021)	To be determined	Initial studies for this scope of work commenced in 2019. Timeframe for this activity is outlined further in the accepted WOMPs for relevant wells in WA-28-L. Woodside considers complete removal of all infrastructure as the base case for decommissioning, as per the OPGGS Act (**Section 1.10.1.1**).
Decommissioning of subsea infrastructure	Activity to be completed by end of 2024 (planned EP submission date: 2023)	To be determined	Initial studies for this scope of work commenced in 2019. Woodside considers complete removal of all infrastructure as the base case for decommissioning, as per the OPGGS Act (**Section 1.10.1.1**).

[1] If unable to meet suitable weather window, may be delayed until the next suitable weather window year end 2021–2022

[2] as per response provided in NOPSEMA Inspection Recommendation Closeout 1891-3

3.4.1 SIMOPS

Simultaneous operations (SIMOPS) may occur throughout the Petroleum Activities Program, if vessel and equipment availabilities permit. A SIMOPS plan will be developed for the Petroleum Activities Program. Execution of the Petroleum Activities Program around existing infrastructure has been included in the scope of risk assessment for this EP (**Section 6**).

3.5 Infrastructure Overview

This section provides a high level overview of the infrastructure relevant to consideration of the environmental risks and impacts of the Petroleum Activities Program. The subsea layout of the Enfield field is provided in **Figure 3-3**. Further details of the infrastructure and field layout are provided in the sections which follow.

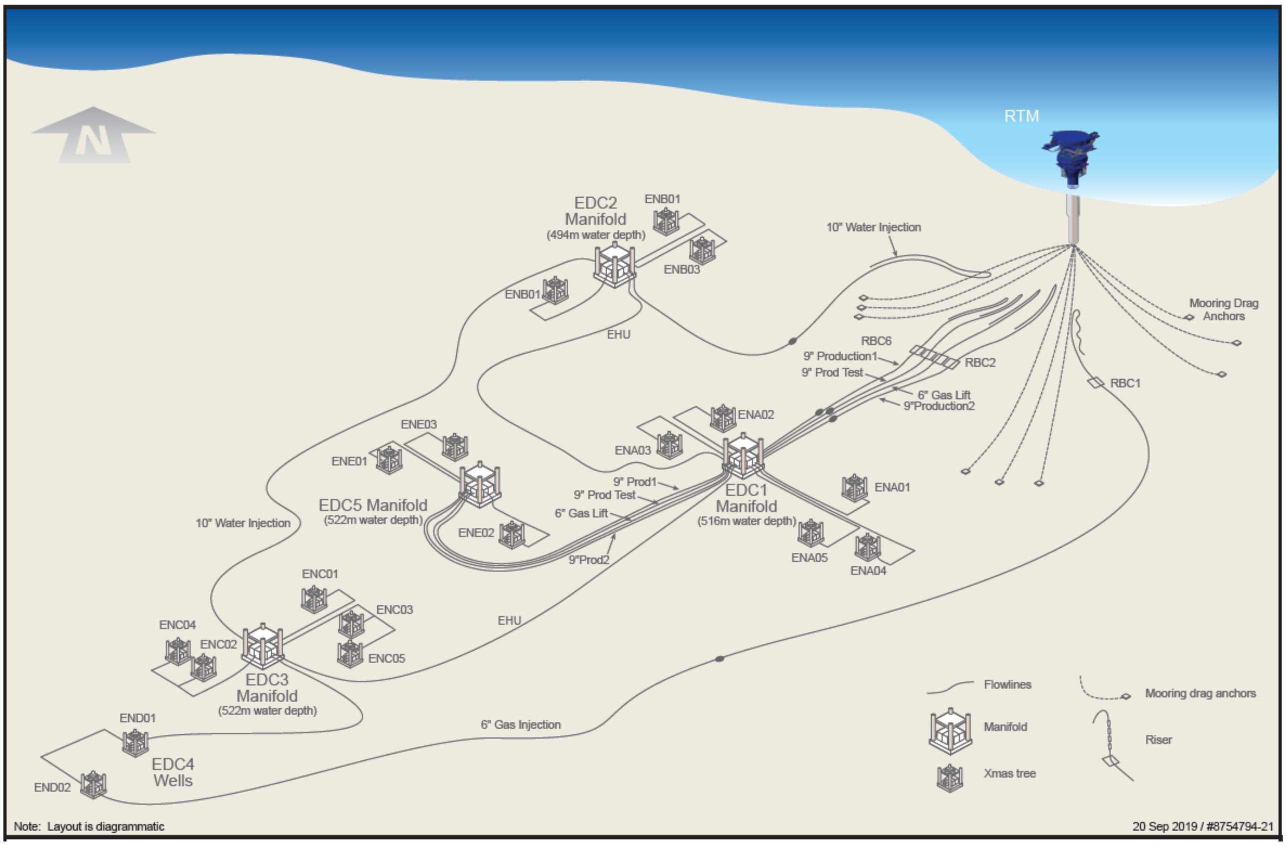


Figure 3-3: Enfield field subsea layout

3.5.1 RTM

The RTM comprises a riser column that is anchored to the seabed by three sets of three catenary anchor mooring chains (**Figure 3-3**). The lower end of each mooring chain is connected to a drag anchor embedded into the seabed. The RTM is about 83 m long and between 4.5 m and 8.5 m in diameter below the waterline, with three decks up to 12.5 m wide above the waterline (**Figure 3-3** and **Figure 3-4**). The riser column extends about 6.5 m above the waterline and weighs about 2529 tonnes, which includes solid and seawater ballast.

The RTM has 14 compartments, 11 of which are ballastable, separated by horizontal watertight bulkheads. In general the compartments are designed to allow the RTM to be upright while in operation, and to allow rotation to a horizontal orientation for towing to and from the field during installation and decommissioning. The layout of the RTM is shown in **Figure 3-4**.

Compartment 13 (at the waterline) contains about 65 m^3 of polyurethane foam. The bottom compartment (compartment 1) is partially filled with about 325 tonnes of iron ore, 80 tonnes of concrete keel, and additional seawater. The second bottom compartment (compartment 2) contains seawater ballast, which was designed to manage RTM draft should additional risers be added. Compartment 2 is also a primary ballast compartment, required by design, along with compartments 3 and 11 to be the only three compartments to be deballasted for rotating the RTM from vertical to horizontal to achieve the minimum draft for onshore disposal (**Section 3.6**).

The RTM contains 11 j-tubes that run the length of the RTM, seven of which are occupied by six risers and one EHU. The j-tubes are tubular conduits that have the shape of the letter “J”. The tubes are used to protect and route the risers and EHU through the inside of the RTM.

The risers connected to the RTM were flushed during the subsea flowline and riser flushing described in **Section 3.5.2.2**. In Q4 2018 they were cut about 10 m below the RTM and the flowline end connected to the subsea infrastructure was capped with an environmental plug. All buoyancy modules on the risers were removed, and the risers were laid on the seabed. The RTM remains, held in place by the catenary anchor chains.

The RTM has a navigation aid system comprising solar-powered marine navigation lights, passive and active radar reflectors to enhance marine radar detectability, and a remote draft monitoring system (**Figure 3-5**). In March 2020, two new navigation lighting units were installed to replace the previous units. The RTM is monitored from the Ngujima Yin FPSO (located about 8 km north-east) and is being maintained until removal. A 500 m petroleum safety zone is being maintained around the RTM structure, which will be removed once the RTM has left its current location. A temporary 500 m operational exclusion zone will be established around the RTM during towing, placement on the seabed, stabilisation and modification activities associated with it becoming an IAR.

The RTM was planned to be removed after FPSO sail away in 2018, as part of the same campaign. As this was unable to be completed (**Sections 1.1** and **3.6**), a revised removal period is planned (**Section 3.4**). **Section 3.6** describes the removal options assessed and the selected option.

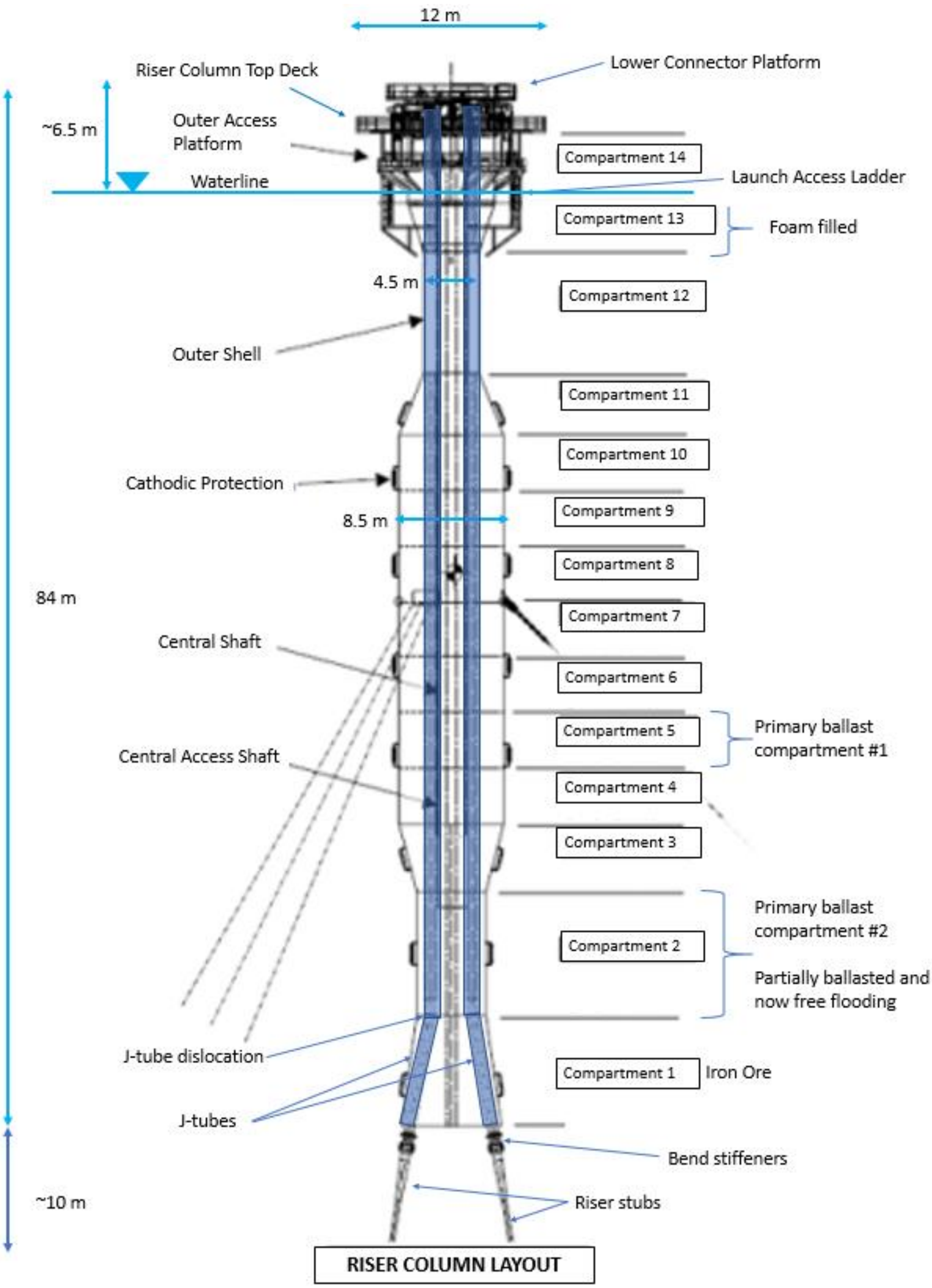


Figure 3-4: RTM layout

Figure 3-5: Topsides section of the RTM

3.5.2 Subsea Infrastructure

During operation, the subsea system facilitated the production of Enfield reservoir fluids and transported these fluids to the FPSO, with reinjection of produced formation water and gas back into the reservoir. The subsea system is in a state of preservation.

The subsea system in Operational Area 1 consists of (see **Figure 3-2**):

- trees/wells
- rigid spools
- manifolds
- electric and hydraulic jumpers
- flexible flowlines
- umbilicals
- risers.

The disconnected infrastructure will be left in place on the seabed for future field decommissioning. Refer to **Section 3.3** for a full list of infrastructure and coordinates and **Section 3.4** for decommissioning timing.

3.5.2.1 Well Configuration

Oil from the Enfield reservoir was produced through six horizontal wells and two deviated wells, configured in a cluster arrangement around two production manifolds connected by rigid spools. Reservoir lift was facilitated through eight water injection wells with two manifolds connected by rigid spools, and two gas injection wells, that were tied back to the Nganhurra (NGA) facility by flexible flowlines and risers. Coordinates of the wells are provided in **Table 3-2**.

Wells were controlled by a multiplexed subsea control system and electro-hydraulic umbilicals connected via the manifolds to the FPSO, and were operated from the integrated control system in the Central Control Room. Each well is completed with a subsea tree incorporating wellhead controls for opening and closing the valves to isolate and regulate flow. The primary down-hole safety system is surface controlled subsurface safety valves (SCSSSV) on each well, which are installed in the production tubing about 100 m below the mudline.

The wells were shut-in in Q4 2018 and are currently in a state of preservation. Shut-in of the wells consists of the SCSSSV being closed and a minimum of two Xmas tree valves being closed, which have been tested and verified. A mechanical barrier (blind seal plate) between the production tubing and the production/gas injection spools was installed by ROV. The blind seal plates provide positive isolation between the production (and gas/water injection) systems and the flushed manifold, flowline and riser system. These blind seal plates provide positive isolation to support the well isolations but are not considered a well barrier. Well integrity of subsea production, gas injector and water injector wells has been completed in accordance with the current Well Operations Management Plan (WOMP) for suspension for an extended period of time.

3.5.2.2 Flowline and Riser System

The production fluids were transported to the FPSO via two 9-inch production flowlines. There is also one 8-inch production test flowline, one 10-inch water re-injection flowline, one 6-inch gas injection flowline and one 6-inch gas lift flowline. There are two production dynamic risers, one test dynamic riser, one water reinjection, one gas lift and one gas reinjection dynamic riser.

The flowline and riser system has been flushed and cleaned of hydrocarbons to ALARP, and put into a state of preservation with treated seawater and laid on the seabed.

The flowline and riser system were redirected into a loop such that the loop could be flushed from the FPSO, with flushing fluids returning to the FPSO for testing and the water processed through the topsides processing system to remove the hydrocarbons. Two loops were created and flushed and cleaned of hydrocarbons to ALARP concentrations in Q4 2018. A final flush with treated seawater was completed to preserve the risers and flowlines until final decommissioning. The gas injection riser was unable to be looped, and was flushed with pure seawater.

All flushing water was then re-injected using the water injection flowline, which was also flushed with treated seawater. Flushing until an ALARP concentration had been reached was determined by monitoring hydrocarbon concentrations in the flushed water as it returned to the FPSO. The ALARP position was defined and implemented as follows: Flushing was continued until the concentration approached an asymptote and hydrocarbon concentrations in the flushed water were no longer decreasing.

Final oil in water (OIW) concentrations of the subsea flowline and riser system are provided in **Table 3-4**.

Table 3-4: ALARP oil-in-water concentrations measured from subsea flushing

Flowline or Riser	OIW (mg/L)
Production Test Flowline to Production Flowline 1	28.2
Gas Lift Flowline to Production Flowline 2	42.2
Gas Injection Flowline	19.7
Water Injection Flowline	Residual*

** Unable to be measured as the flushing water was injected into the reservoir via this flowline and there is no ability to take a water sample at the well end to measure the residual OIW concentration.*

3.6 RTM Removal and Disposal Method Options Assessment

3.6.1 Overview

Section 3.6 details the assessment that Woodside has conducted to determine the most reasonably practicable decommissioning option for the RTM and to ensure this option has equal or better outcomes to that previously accepted by NOPSEMA. The assessment includes:

- A summary of the background of the activity to decommission the RTM, including why the previously accepted decommissioning option, as presented in Revision 2 of this EP (**Section 1.1**), is no longer practicable (**Section 3.6.1.1**).
- An outline of the process taken to identify and evaluate alternative methods for decommissioning the RTM, including alternative options for achieving onshore disposal and possible repurposing or offshore disposal options (**Section 3.6.1.2**).
- A description of each of the options identified (Section 3.6.2).
- A comprehensive evaluation of each option identified including:
  - assessment against all legislation applicable to the activity (**Section 3.6.3.1**)
  - assessment of the practicability of each option, which includes an evaluation of the technical feasibility, schedule considerations, health and safety risks, and environmental impacts and risks associated with each option (**Section 3.6.3.2**)
  - assessment of equal or better outcomes associated with alternative options identified to the previously accepted option of removal from the title area and onshore disposal (**Section 3.6.3.3**).

The recommended option identified from this assessment is to repurpose the RTM as an IAR—this option meets legislative requirements, is technically feasible, can be achieved within the required schedule, has comparable health and safety risks relative to onshore disposal options, and provides for overall equal or better outcomes in terms of the environmental impacts, risks and benefits associated with repurposing the RTM as an IAR. As the recommended option, repurposing of the RTM as an IAR has been carried through this EP as the proposed activity. This includes:

- describing the activities associated with designing the IAR, selecting a location for it and executing its installation (**Section 3.7.4**)
- describing the existing environment that could be impacted from these activities or from the long-term presence of the IAR (**Section 4**)
- summarising feedback received from stakeholders on the proposed option and how any concerns have been addressed (**Section 5**)
- comprehensively evaluating the impacts, risks and benefits of the IAR including demonstration that any residual impacts and risks have been managed to ALARP and are acceptable, and that benefits from the IAR will be achieved through by implementing EPOs, controls, EPSs, and MC (**Section 6.7**).

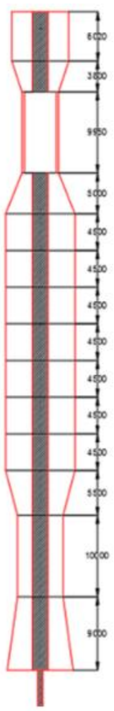
3.6.1.1 Background

Initial cessation activities for Nganhurra operations were undertaken between December 2018 and February 2019. Following sail away of the FPSO and disconnection of the risers from the RTM, it was planned to remove the NGA RTM by disconnecting the mooring chains, reballasting the RTM from vertical to horizontal and towing it for onshore disposal at Henderson. This option was approved under the Nganhurra Operations Cessation EP (Revision 2) (**Section 1.1**).

During the initial RTM ballasting activities, the integrity of a primary water ballast compartment (compartment 2) was found to be compromised and tests demonstrated seawater ingress through j-tube #11 into the ballast compartment. Therefore, this compartment could not be emptied of seawater to create buoyancy and rotate the RTM to a horizontal position for towing and entry into a ship lift for onshore disposal at Henderson. The root cause of the failure is unexpected corrosion resulting from a late change to the RTM design (**Section 1.1**).

As a result, the RTM was left moored on location and decommissioning activities suspended to allow further assessment of the failure mechanism and the impact on the onshore disposal option. The current status of each compartment of the RTM is presented in **Table 3-5** (compartments are numbered from the bottom of RTM up (i.e. compartment #1 is at the bottom).

Table 3-5: Status of RTM compartments

RTM	Compartment	Volume (m^3)	Contents	Ballastable/ Deballastable in current condition	Ballasting/ Deballasting Required for Upending
	#14	215	Personnel access (empty)	N/A	N/A
	#13	92	Foam filled	N/A	N/A
	#12	42	Tidal tank (freeflooding)	N/A	N/A
	#11	160	Empty	Yes[1]	Yes (ballast)
	#10	247	Empty	No	No
	#9	247	Empty	Yes	No
	#8	247	Empty	Yes	No
	#7	247	Empty	Yes	No
	#6	247	Empty	No	No
	#5	247	Empty	Yes	No
	#4	247	Empty	No	No
	#3	206	Ballasted with 122 tonnes seawater	Yes[2]	Yes (deballast)
	#2	222	Filled with seawater from leak in J-tube #11	No	Yes (deballast)
	#1	315	80 tonne concrete keel (32 m^3), 325 tonnes of iron ore ballast and 205 m^3 of seawater ballast	N/A	N/A

[1] *Can be ballasted by puncturing the outer shell and free flooding the compartment.*

[2] *Requires compartment #2 to be deballasted first.*

Further assessment concluded that without repair to compartment 2, the achievable draft far exceeded the maximum draft of the Henderson ship-lift (9.5 m). Because the J-tube repair scope required to execute the option as planned has high technical complexity and a low probability of success (**Section 3.6.3.2**), it was decided to identify and evaluate alternative options for removing the RTM through an option selection process.

3.6.1.2 Option Selection Process

An option selection process was developed specific to the NGA RTM to identify and evaluate alternative options for decommissioning and to select a preferred option that meets legislative requirements, is practicable, and if not the previously accepted option of onshore disposal, has an equal or better environmental outcome to onshore disposal. The option selection process included these steps:

- options identification
- options evaluation and selection.

Options Identification

The options identification process focused on identifying potential alternative methods to achieve full removal of the RTM from the title area and onshore disposal, in accordance with the accepted EP (taking into consideration its current condition, **Section 3.6.1.1**), as well as potential offshore repurposing and disposal options. The identification of options focused on ensuring all potential onshore disposal options were identified for evaluation. The options identified are presented in **Section 3.6.2**.

Options Evaluation and Selection

The key steps in evaluating and selecting an option were:

- Legislation – evaluate the ability of the options to comply with the OPGGS Act and Sea Dumping Act
- Practicability – assess the reasonable practicability of each option, based on technical feasibility, schedule, health and safety risk, and environmental impact and risk
- Equal or Better Environmental Outcome – test each option considered reasonably practicable (other than full removal and onshore disposal, consistent with the accepted EP) to determine if it is likely to result in an equal or better outcome when compared to onshore disposal (DIIS, 2018).

The options evaluation and selection is presented in **Section 3.6.3**. Note: Well integrity (DIIS, 2018) is not included as a criteria as it is not relevant to decommissioning of the RTM. A separate EP for permanent plug and abandonment of wells in WA-28-L is scheduled to be submitted in 2021 (**Section 1.1**).

3.6.2 Options Identification

These options were identified via the options identification process:

1. Onshore disposal:
   a) repair and wet tow to Henderson
   b) repair, wet tow to sheltered water, float onto semi-submersible vessel and transport to shore
   c) repair, wet tow to sheltered water, lift onto heavy lift vessel (HLV) and transport to shore
   d) no repair, no wet tow, lift with heavy construction vessel (HCV) onto the vessel and transport to shore
   e) no repair, vertical / semi-horizontal wet tow to a deepwater port.
2. Offshore disposal:
   a) no repair, vertical wet tow to reef location, sink and augment into IAR
   b) no repair, vertical / semi-horizontal wet tow to much deeper water and sink
   c) no repair, no or short vertical wet tow, sink in the title area.

The main steps required for each option are outlined in the following subsections.

3.6.2.1 Onshore Disposal – Option 1a (Original Plan with Repair)

The intent of this option is to deballast the RTM to a horizontal draft suitable to bring the RTM onshore, as originally planned, to the disposal contractor’s base in Henderson. The restriction of this option is that the draft of the RTM at the end of the wet tow must be no more than 9.5 m. The main steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for deballasting RTM to horizontal.
- Repair works
  - remove topsides spoolwork to access top of risers
  - install riser removal equipment
  - remove riser sections from RTM
  - remove bend stiffeners (optional)
  - clean inside of j-tubes
  - inspect and verify inside surface of j-tubes are suitable for plug seal
  - grout/mechanically plug j-tubes
  - confirm/verify seal integrity of grout/mechanical plugs.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical until ready to rotate to horizontal)
  - deballast the RTM to about 9.5 m draft (maximum draft of Syncro-Lift at Henderson)
  - secure AHT to RTM
  - disconnect/cut final mooring chain(s).
- Wet tow RTM to onshore disposal location Henderson (about 1500 km).
- Remove RTM from water and undertake onshore disposal activities.

3.6.2.2 Onshore Disposal – Option 1b (Semi-submersible Vessel)

The intent of this option is to deballast the RTM to a horizontal draft suitable to float the RTM onto a semi-submersible vessel, lift the RTM using the semi-submersible, and transport for onshore disposal. The main steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for deballasting RTM to horizontal.
- Repair works
  - remove topsides spoolwork to access top of risers
  - install riser removal equipment
  - remove riser sections from RTM
  - remove bend stiffeners (optional)
  - clean inside of j-tubes
  - inspect and verify inside surface of j-tubes are suitable for plug seal
  - grout/mechanically plug j-tubes
  - confirm/verify seal integrity of grout/mechanical plugs.
- Cut mooring chains and deballast RTM

- perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical until ready to rotate to horizontal)
- deballast the RTM to about 10–14 m draft (deballasting requirement depends on semi-submersible selected)
- secure AHT to RTM
- disconnect/cut final mooring chain(s).

- Wet tow RTM to sheltered calm waters (Legendre Island, about 500 km away).
- Re-float RTM from water with a semi-submersible vessel.
- Transport RTM to onshore disposal location (minimum 3000 km dry tow to port with suitable draft requirements in Batam, Indonesia, or Singapore in Southeast Asia).
- Remove RTM from vessel and undertake onshore disposal activities.

3.6.2.3 Onshore Disposal – Option 1c (Transport Heavy Lift Vessel (HLV))

The intent of this option is to deballast the RTM to a near horizontal position, deballast sufficiently to create a load able to be lifted by a HLV, and transport for onshore disposal. The main steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for deballasting RTM to horizontal.
- Repair works
  - remove topsides spoolwork to access top of risers
  - install riser removal equipment
  - remove riser sections from RTM
  - remove bend stiffeners (optional)
  - clean inside of j-tubes
  - inspect and verify inside surface of j-tubes are suitable for plug seal
  - grout/mechanically plug j-tubes
  - confirm/verify seal integrity of grout/mechanical plugs.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical until ready to rotate to horizontal)
  - deballast RTM to about 10 m draft (near horizontal required)
  - secure AHT to RTM
  - disconnect/cut final mooring chain(s).
- Wet tow RTM to sheltered calm waters (Legendre Island, about 100–500 km away)
- Install lifting arrangement and connect to HLV cranes.
- Lift RTM from water with a transport HLV.
- Transport RTM to onshore disposal location (minimum 3000 km dry tow to port with suitable draft requirements in Batam or Singapore in Southeast Asia).

- Remove RTM from vessel and undertake onshore disposal activities.

3.6.2.4 Onshore Disposal – Option 1d (Heavy Construction Vessel (HCV))

The intent of this option is to lift the RTM directly out of the water using a HCV and transport for onshore disposal. The benefit of this option is that the j-tubes do not need to be repaired. The main steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for deballasting RTM to horizontal
  - install trunnion onto FPSO lift point
  - install lifting frame (donut) winch based system (requires removal of handrails).
- Subsea lifting frame (donut) installation
  - install and secure lifting frame onto bottom of RTM with ROVs and topsides winches
  - secure winch wire system to RTM and clear all topsides equipment.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical until ready to rotate to horizontal)
  - connect top and bottom lift rigging to each split block on HCV
  - deballast RTM to near horizontal
  - disconnect/cut final mooring chain(s).
- Lift RTM
  - commence lift of lower end to bring RTM to near horizontal
  - lift RTM from water
  - place RTM onto cradles/seafastenings on HCV or other barge.
- Transport RTM to onshore disposal location (minimum 3000 km dry tow to port with suitable draft requirements in Batam or Singapore in Southeast Asia).
- Remove RTM from vessel and undertake onshore disposal activities.

3.6.2.5 Onshore Disposal – Option 1e (Deep Port)

The intent of this option is to wet tow the RTM, in a vertical or semi-horizontal orientation to a deepwater port location for onshore disposal. The main steps required for this option includes:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for deballasting RTM to horizontal.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical until ready to rotate to semi-horizontal)
  - deballast RTM for wet tow (if possible orientate to semi-horizontal to assist tow)
  - secure AHT to RTM
  - disconnect/cut final mooring chain(s).

- Wet tow RTM to deepwater port (about 3000 km tow to port with suitable draft requirements in Batam).
- Remove RTM from water and undertake onshore disposal activities (may require some deballasting inshore).

3.6.2.6 Offshore Disposal – Option 2a (IAR)

The intent of this option is to wet tow the RTM vertically to a nearby reefing location, place the RTM on the seabed, and augment it into an IAR by placing concrete reefing modules on the seabed. The main offshore steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for tow and sinking of the RTM
  - flush chemical and hydraulic lines and decant drain pot
  - remove bulk plastics from topsides, including electrical cables and chemical hoses
  - prepare risers for removal once RTM is on the seabed.
- Subsea preparations
  - cut and recover riser bend stiffeners including riser tails.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence
  - secure AHT to RTM
  - disconnect/cut final mooring chain(s).
- Wet tow RTM in vertical orientation to pre-approved reefing location (about 26 km).
- Sink RTM onto seabed in a horizontal orientation.
- Perform IAR activities
  - remove and recover flexible risers and dynamic umbilical from RTM
  - remove any remaining bend stiffener non-metallic material (where possible)
  - cap any remaining bend stiffener non-metallic material with grout
  - flood compartments to stabilise RTM on seabed
  - grout compartment #13 foam
  - augment RTM with reef modules.

3.6.2.7 Offshore Disposal – Option 2b (Deep Water)

The intent of this option is to wet tow the RTM, in a semi-horizontal orientation where possible (otherwise vertically) to a deepwater sea disposal location and sink it in >2000 m water depth. The main offshore steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for tow and sinking of the RTM
  - flush chemical and hydraulic lines and decant drain pot
  - remove bulk plastics from topsides including electrical cables and chemical hoses.

- Subsea preparations
  - cut and recover riser bend stiffeners including riser tails.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical until ready to rotate to semi-horizontal)
  - secure AHT to RTM
  - disconnect/cut final mooring chain(s).
- Wet tow RTM in semi-horizontal or vertical orientation to pre-approved deepwater disposal location (potential location identified about 370 km from RTM's current location).
- Sink RTM.

3.6.2.8 Offshore Disposal – Option 2c (in title area)

The intent of this option is to minimise any repair works and limit or eliminate RTM tow distance by sinking the RTM within the title area. The main offshore steps required for this option include:

- Topside preparation works
  - transfer personnel to/from the RTM
  - remove miscellaneous items in preparation for short tow and sinking of the RTM
  - flush chemical and hydraulic lines and decant drain pot
  - remove bulk plastics from topsides including electrical cables and chemical hoses
  - prepare risers for removal once RTM is on the seabed.
- Subsea preparation
  - cut and recover riser bend stiffeners including riser tails.
- Cut mooring chains and deballast RTM
  - perform mooring chain disconnection sequence in combination with RTM ballasting (to keep RTM vertical)
  - secure AHT to RTM (if wet towing within tile area)
  - disconnect/cut final mooring chain(s).
- Wet tow within title area to selected location (if required[3]).
- Sink RTM onto seabed in a horizontal orientation.
- Seabed works
  - remove and recover flexible risers and dynamic umbilical from RTM
  - remove any remaining bend stiffener non-metallic material (where possible)
  - cap any remaining bend stiffener non-metallic material with grout
  - flood compartments to stabilise RTM on seabed
  - grout compartment #13 foam.

[3] Dependent on approval of sea dumping permit application

3.6.3 Options Evaluation and Selection

3.6.3.1 Legislation Assessment

Each option has been assessed against key legislation to determine if it is expected to meet legislative requirements. Key legislation relevant to the options for final decommissioning of the RTM are described below. Legislation that applies to the Petroleum Activities Program are outlined in **Section 1.10.1**.

Applicable Legislation

OPGGS Act

The Offshore Petroleum Decommissioning Guideline (DIIS, 2018) states that the complete removal of infrastructure and the plugging and abandonment of wells is the default decommissioning requirement under the OPGGS Act.

Options other than complete removal may be considered; however, the titleholder must demonstrate that the alternative decommissioning approach delivers equal or better environmental, safety and well integrity outcomes to complete removal and that it complies with all other legislative requirements (DIIS, 2018). Titleholders can demonstrate these matters by submitting permissioning documents under the OPGGS regulations. Permissioning documents include an EP, prepared and submitted in accordance with the Environment Regulations, and a Safety Case, prepared and submitted in accordance with the *OPGGS (Safety) Regulations 2009* (Safety Regulations) (DIIS, 2018).

Sea Dumping Act

As outlined in **Section 1.10.1.3**, in Australia the Sea Dumping Act regulates the disposal at sea of platforms, vessels, aircraft and other manufactured items. If the RTM is to be permanently disposed of at sea, it will require an sea dumping permit. If the RTM is to be repurposed into an IAR, an application would need to be made under the Sea Dumping Act for an artificial reef permit.

There are Australian precedents for RTMs to be purposefully sunk under accepted artificial reef permits. The two most recent are the Jabiru RTM buoy and the Challis Single Anchor Leg Rigid Arm Mooring, which were both dumped at sea, following an extensive evaluation including safety, environment, cost and stakeholder consultation (PTTEP Australia, 2015).

The benefits of leaving structures in place ('in situ') have been demonstrated in several parts of the world, notably in the Gulf of Mexico, where offshore facilities frequently become artificial reefs (Bureau of Safety and Environmental Enforcement, 2019). An IAR was also recently created near Exmouth (King Reef) under an artificial reef permit. Six steel structures (mid-rise buoys) from BHP's Griffin oil and gas facility were decommissioned, cleaned, repurposed and deployed on the ocean floor within Exmouth Gulf, along with 49 purpose-built concrete reefing modules. King Reef has created >27,000 m^3 of new underwater habitat, providing food and shelter for more than 50 different types of marine life, including a variety of fish, marine turtles, sea snakes, sharks and rays (Recfishwest, 2018).

Before receiving a permit, items for disposal (and where relevant, associated policies and guidelines) must be assessed for suitability and acceptability under the Sea Dumping Act. The item must be cleared of any material that may pose an environmental, safety or quarantine risk. Assessment of the RTM shows that it meets the suitability and acceptability requirements under the Sea Dumping Act.

Under the Sea Dumping Act, there is a requirement for disposal via an sea dumping permit to demonstrate that the hierarchy of waste management options, which includes re-use, has been considered (DoEE, 2019a). If the RTM is to be sunk for the sole purpose of disposal, the recommendations for selecting a sea dumping location are "*a location with waters at least 2,000 m* *deep, at least 50 nm from the coast and at least 20 nm from the nearest historic shipwreck, sub-sea cable, pipeline, oil/gas well, reef, seamount, bank or shoal. The site would also be clear of normal shipping routes and active marine fauna migration routes and breeding areas*." (DoEE, 2019b).

If the RTM is to be repurposed to create an IAR under an artificial reef permit, the permit requires selection of a suitable site, stakeholder consultation and assessment of social, economic, biological and environmental considerations as part of the artificial reef permit application process (DoEE, 2019c). Typical requirements are to select a coastal water location, within a reasonable distance of public access points such as a boat ramp (if the purpose is for recreational purposes and not solely for habitat enhancement), and away from locations where it could pose a hazard to shipping traffic or other marine users.

Safety Regulations

A facility cannot be constructed, installed, operated, modified or decommissioned without a safety case in force for each stage in the life of the facility (NOPSEMA, 2018). A safety case is a document produced by the operator of a facility that identifies the hazards and risks, describes how the risks are controlled and describes the safety management system in place to ensure the controls are effectively and consistently applied, in accordance with the Safety Regulations. Safety cases are regulated by NOPSEMA. NOPSEMA assesses safety cases and accepts a safety case if it is satisfied that the arrangements set out in the document demonstrate that the risks will be reduced to ALARP (NOPSEMA, 2018). A safety case was accepted in August 2018 by NOPSEMA for the proposed NGA cessation of operations activities.

Given that the option evaluation and selection process includes health and safety risk as a criteria, which is the focus of the Safety Regulations, the options were not separately assessed against the Safety Regulations.

Environment Regulations

This EP was developed to satisfy the requirements under the Environment Regulations to have an accepted EP in place before undertaking any petroleum activity, including decommissioning.

Given that the option evaluation and selection process includes environmental impacts and risks as a criteria, which is the focus of the Environment Regulations, the options were not separately assessed against the Environment Regulations.

Evaluation against Legislation

An assessment of each option against the OPGGS Act and Sea Dumping Act is outlined in **Table 3-6**. Based on this assessment, all options for decommissioning the RTM are either acceptable (1a–1e, 2a) or have the potential to be acceptable (2b, 2c) under legislation and, therefore, all options were carried into the practicability assessment (**Section 3.6.3.2**).

Table 3-6: Assessment of options against relevant legislation

Option	Applicable legislation	Strengths	Weaknesses	Conclusion
Option 1a: Repair and Wet Tow ***Option 1b:*** Repair and Semi-submersible ***Option 1c:*** Repair and HLV ***Option 1d:*** Infield HCV ***Option 1e:*** Tow to deepwater port	OPGGS Act	• Meets base case requirements under the Act for complete removal from title area, and aligns with currently accepted decommissioning option (onshore disposal).	• None identified.	Options broadly acceptable
	Sea Dumping Act	N/A	N/A	
Option 2a: Repurpose as IAR	OPGGS Act	• Meets base case requirements under the Act for complete removal from title area.	• Does not achieve currently accepted EP option (onshore disposal). • Subject to approval under other legislation (e.g. Sea Dumping Act).	Option broadly acceptable
	Sea Dumping Act	• Repurposing rather than disposal as per waste management hierarchy. • Potential socio-economic and environmental benefit associated with artificial habitat.	• Requires demonstration of acceptability of repurposing the structure (e.g. finding a suitable location for the IAR and ensuring stakeholder support).	
Option 2b: Deepwater Disposal	OPGGS Act	• Meets base case requirements under the Act for complete removal from title area.	• Does not achieve currently accepted EP option for onshore disposal option. • Subject to approval under other legislation (e.g. Sea Dumping Act).	Option broadly acceptable

Option	Applicable legislation	Strengths	Weaknesses	Conclusion
	Sea Dumping Act	• Environmental acceptability in a deepwater environment is more likely given the more benign receiving environment.	• Management of residual contaminants is more complex due to increased depth.	
Option 2c: Disposal in title area	OPGGS Act	• Permitted if it results in equal or better environmental and safety outcomes when compared to complete removal from title area.	• Does not achieve currently accepted EP option for onshore disposal option. • Subject to approval under other legislation (e.g. Sea Dumping Act).	Option potentially acceptable
	Sea Dumping Act	None identified	• Title area does not meet sea dumping disposal location recommendations: - water depth is between 200 and 2000 m - only 38 km from the coast (North West Cape) - nearest historic shipwreck is 9 km from Operational Area 1 - only 2 km from the Enfield reservoir and associated infrastructure - overlaps humpback whale and pygmy blue whale migration biologically important areas (BIAs). • Management of residual contaminants is more complex due to increased depth.	

3.6.3.2 Practicability Assessment

Option practicability was evaluated based on the criteria of technical feasibility, schedule, health and safety risk and environmental impact and risk. An evaluation against each criterion is presented below, followed by an assessment of option practicability.

Technical Feasibility

The steps for each decommissioning option described in **Section 3.6.2** were assessed for technical complexity (expected ability to engineer a technical solution) and the probability of success (the expected ability to successfully execute the engineered solution offshore). The definitions used for technical complexity and probability of success are described in **Table 3-8** and **Table 3-9**.

Many of the main steps/activities associated with each decommissioning option are common to all options (e.g. all long tow options would require j-tube repairs); therefore, the technical feasibility assessment was conducted based on these common steps/activities to reduce repetition and allow the common technical challenges to be compared. For each step/activity, the applicable decommissioning options are identified. A summary of the overall technical feasibility assessment for each option is provided in **Table 3-7**; the full assessment for each common step/activity is provided in **Table 3-10**.

Table 3-7: Option technical feasibility summary

Technical Feasibility Summary
Option 1a *Repair and wet tow to Henderson, WA*
Repairing the j-tubes to enable the RTM to be upended and placed into a horizontal orientation for a long wet tow (1500 km) to Henderson has high technical complexity and a low probability of success. Further, the probability of the j-tube repairs remaining intact throughout the wet tow to Henderson, and thereby maintaining a draft of <9.5 m (required to load the RTM onto the ship lift at Henderson), is also considered to have a low probability of success.
Option 1b *Repair, wet tow to sheltered water, float onto semi-submersible vessel and transport to shore*
Repairing the j-tubes to enable the RTM to be upended and placed into a horizontal orientation for a wet tow (550 km) to sheltered water off Legendre Island has high technical complexity and a low probability of success. Further, the probability of the j-tube repairs remaining intact throughout the wet tow to Legendre Island, and thereby maintaining the draft required to float over a semi-submersible vessel, is also considered to have a low probability of success.
Option 1c *Repair, wet tow to sheltered water, lift onto HLV and transport to shore*
Repairing the j-tubes to enable the RTM to be upended and placed into a horizontal orientation for a wet tow (550 km) to sheltered water off Legendre Island has high technical complexity and a low probability of success. Further, the probability of the j-tube repairs remaining intact throughout the wet tow to Legendre Island, and thereby maintaining the draft required to horizontally lift the RTM with one of the largest HLVs in the world, is also considered to have a low probability of success. It must be noted that performing the HLV lift in the Exmouth Gulf does present as a higher probability of success for this HLV lift option as the tow length post RTM repair is less than for Legendre Island. However, social and environmental sensitivities around use of Exmouth Gulf for heavy lifting, vessels on anchor or DP and vessels larger than 100 m in length results in this option being considered not-feasible with the alternate location off Legendre Island selected for inclusion into the HLV lift option.
Option 1d *No repair, no wet tow, lift with HCV onto the vessel (HCV) and transport to shore*
Lifting of the RTM directly out of the water at its current location removes the need to repair the j-tube or to wet tow to another location; however, the RTM structural capacity cannot accommodate a direct vertical lift and has a low probability of successfully rotating the RTM for placing it onto the HCV, resulting in a highly complexity lift with an overall low probability of success. Further, the probability of obtaining a suitable weather window to perform this marginal lift is very low.

Option 1e *No repair, vertical/semi-horizontal wet tow to deepwater port*
This option considers no j-tube repair and hence a vertical (or partial horizontal where possible) wet tow to a deepwater port. The closest identified port to potentially accommodate the RTM in a vertical or near vertical orientation is in Batam, Indonesia about 3300 km from the RTM's current location. With no complex j-tube repairs nor the need for heavy lifting of the RTM, these steps and associated complexities are removed, offering a non-repair alternative to the other onshore disposal option. However, the probability of reaching Batam 3300 km away without issues such as weather or fatiguing of the RTM leading to ballasting issues is considered very low.
Option 2a *No repair, vertical wet tow to reef location, sink and augment into IAR*
The proposed IAR site is a short 26 km away from the RTM's current location. The RTM can be wet towed vertically to the IAR site, thus preventing the need to repair the j-tubes for long wet tow. With no complex j-tube repairs nor the need for heavy lifting of the RTM, this option is confirmed as having the equally lowest complexity of all options and equally the highest overall probability of success. This option also has the highest probability of success in removing the risers from the RTM once the RTM is on the seabed. Overall it is the preferred option from a technical feasibility perspective.
Option 2b *No repair, vertical/semi-horizontal wet tow to much deeper water and sink*
This option considers no j-tube repair and hence a vertical (or partial horizontal where possible) wet tow to a deepwater (2000 m) disposal location about 370 km from the RTM's current location. With no complex j-tube repairs nor the need for heavy lifting of the RTM, these steps and associated complexities are removed, offering an alternative to 2a and 2b but with no RTM remediation work once the RTM is on the seabed. This option has fewer technical steps, but a marginally lower probability of success in towing it to the disposal site (increased distance) than in options 2a and 2c. From a technical feasibility perspective, this option is the least preferred of the offshore options but is preferred over the onshore options.
Option 2c *No repair, no or short vertical wet tow, sink in the title area*
Due to the short tow distance (<5 km) the RTM can be wet towed vertically to the selected location, thus preventing the need to repair the j-tubes for a long wet tow. With no complex j-tube repairs nor the need for heavy lifting of the RTM, this option is confirmed as having the equally lowest complexity of all options and equally the highest overall probability of success. Combined with the slightly lower probability of success in removing the risers from the RTM once the RTM is on the seabed over option 2a, means that this option as technically feasible to undertake and is the second preference of all options from a technical feasibility perspective.

Table 3-8: Technical complexity definitions

Technical Complexity Definition
The criteria used to categorise the ability to engineer a technical solution have been developed in consideration of the Oil and Gas UK Guidelines for Comparative Assessment in Decommissioning Programmes Issue 1 (2015).
LOW COMPLEXITY *Engineering feasibility of the concept is beyond doubt.* • engineering of the concept solution has manageable complexities • the proposed concept has been successfully implemented in the past • industry and expert opinion consistently concludes that the proposed solution is technically robust/attainable • vessels and most supporting equipment are industry standard with a good track record of successful operations; no new marine asset construction is required.
MODERATE COMPLEXITY *Engineering feasibility of the concept requires some additional engineering development.* • engineering of the concept solution is expected to have challenging complexities • the proposed concept has been seriously considered for several directly comparable assets in the past but has not yet been used • expert opinion is united in confidence that the proposed solution is generally technically sound • some vessels require minor development investment; however, there is widespread confidence within the industry that this can be completed successfully.

Technical Complexity Definition
HIGH COMPLEXITY *Engineering feasibility of the concept requires considerable engineering to prove.* • engineering of the concept solution is uncertain with challenging complexities that are unresolved • the proposed concept is not mature • there is some doubt within the industry, and expert opinion is divided on whether the proposed solution is technically sound • vessels require development and construction investment.

Table 3-9: Probability of success definitions

Probability of Success
The probability of successfully executing the proposed solution offshore has been categorised into “Low”, “Medium” and “High”. Note: This is a probability rating for option assessment purposes only; any option that is progressed would need to demonstrate a near-certain probability of success to obtain approval for any offshore work to proceed.
HIGH PROBABILITY OF SUCCESS (80+%) Anticipated technical complexities and/or unmitigated influencing factors carried out offshore are limited and manageable with limited consequence leading to high probability of successful execution of the proposed solution.
MODERATE PROBABILITY OF SUCCESS (50–80%) Anticipated technical complexities and/or unmitigated influencing factors carried out offshore are expected to have a moderate probability of occurring, which could lead to unsuccessful execution and completion of the proposed technical solution.
LOW PROBABILITY OF SUCCESS(<50%) Anticipated technical complexities and/or unmitigated influencing factors carried out offshore are expected to have a high probability of occurring, with a low probability of being able to successfully execute and complete the proposed technical solution.

Table 3-10: Technical feasibility of common activities

Deballasting RTM to a Horizontal Draft of Less than 9.5 m *Applicable to Option 1a, 1b and 1c*
The original RTM disposal plan was to deballast the RTM to 9.5 m at the riser tails (7.9 m at the keel), which is the Syncro-Lift limit at the contractor’s facilities in Henderson. The Syncro-Lift was to be used to raise the RTM from the water on supports for removal to onshore disposal location. To achieve this target of 9.5 m draft, compartment #2 was to be deballasted, compartment #3 deballasted to a remaining water volume of no more than 15% and compartment #11 ballasted/filled to at least 95% full. Currently compartment #2 is unable to be deballasted due to the j-tube failure causing free flooding of seawater into the compartment. Compartment #3 cannot be deballasted until the RTM has been partially deballasted (planned after compartment #2 deballasting) to provide a lower head pressure. Compartment #11’s ballasting valve has since been identified as being inoperable and, hence, cannot be used to ballast compartment #11. However, as compartment #11 was to be fully flooded, penetrating the outer shell at compartment #11 location would obtain a similar outcome. Therefore the resulting constraint that prevented and still prevents deballasting of the RTM to horizontal (or near horizontal) is compartment #2 j-tube integrity failure. The ability to attain a near horizontal draft plays a significant factor in assessing the options for removing and disposing of the RTM, as a horizonal orientation (<9.5 m draft) is required for the RTM to enter shallow ports such as the original planned port at Henderson. A <9.5 m draft would also allow the RTM to be floated onto a semi-submersible vessel or lifted horizontally using a HCV/HLV. These options to deballast the RTM were considered: • repair compartment #2 j-tube failure(s) to allow deballasting • use pumpable buoyancy in compartment #2 to displace the water • use alternative compartments for deballasting • use buoyancy bags.

Deballasting RTM to a Horizontal Draft of Less than 9.5 m *Applicable to Option 1a, 1b and 1c*
J-Tube Repair
The source of the hole in j-tube #11 (empty j-tube) has been confirmed as the outcome of a galvanic corrosion cell localised and common to the bend section of each of the 11 j-tubes. Inspection of the empty j-tubes confirmed failure of j-tube #11 at this location and further showed increased marine grow outcrops at the same location in the other two empty j-tubes inspected, which can indicate accelerated corrosion in that local area. Therefore, it is expected that some of the other populated j-tubes will also have similar corrosion issues at this location. As all the bends in the j-tubes occur within compartment #2, any holes in other j-tubes from a similar galvanic corrosion event will be contained within compartment #2. Removing the six flexible risers and one dynamic umbilical (EHU) from within the j-tubes would need to be undertaken to allow equipment to be run inside the j-tubes to clean and inspect them prior to grouting/mechanical plugging operations. The technical feasibility of removing the risers is described below. Cleaning of the j-tubes would be by specialist equipment which would run inside each j-tube and, using high pressure water, blast the marine growth and any corrosion scale from the walls of the j-tube to allow inspection via remote camera and inspection tooling. There are a couple different systems available in the market which would need detailed assessment and possible modifications to accommodate the intended scope making the process moderately technically complex. Cleaning and inspecting the section of all 11 j-tubes required to plug compartment #2 is expected to take 2–3 weeks of continuous work. To seal any holes with grout, following removal of the flexible risers, dynamic umbilical and j-tube cleaning, a fabric sleeve would be inserted inside the j-tube(s) over the hole(s), followed by pumping grout from the base of the j-tube filling the j-tube(s) up past each hole effectively creating a solid plug. Using mechanical plugs, a plug would be set below and above the j-tube holes which would also need a good clean surface to facilitate a good seal. After grouting/setting these mechanical plugs, a pressure test via compartment #2 would need to be performed to confirm an adequate seal. Where grout is used, any failure in the seal would result in extensive rework to remove the set grout, clean the j-tube, reset the fabric sleeve and repump grout. To date Woodside has not used grout or mechanical plugs, nor is it aware of anyone using grout or mechanical plugs in this manner to obtain such a critical seal. The technical complexity of this solution is high, with uncertainty on both the initial sealability of the grout and on retaining that seal throughout the RTM's wet tow (due to likely inherent flex of the structure under metocean conditions) to an onshore disposal location or to sheltered water for refloat or lift. Failure of the grout or movement of the plugs even marginally may result in water leakage into compartment #2 and loss of draft during upending or during wet tow. These findings were further confirmed by a third-party technical assessment. Therefore, repairing the j-tubes is considered to have a high level of technical complexity with a low probability of success.
Pumpable Buoyancy
As a standalone, or in combination with grouting/mechanical plugging the j-tubes, the use of pumpable buoyancy (micro-spheres) to displace water within compartment #2 was considered, however, the total calculated volume of water that would be displaced by the micro-spheres would not be sufficient to achieve the required draft and, as this technology is still at 'Technological Readiness Level 5', the associated technical complexities and probability of success are unknown at this time making it impractical to use. *Note: Technological Readiness Level was developed by NASA in the 1970s, and globally adopted as a system for estimating the maturity of a particular development. The scale runs from 1 to 9, with 9 being "actual system proven in operational environment".* Consideration was also given to the low reliability of retaining the micro-spheres within compartment #2 throughout the duration of deballasting and any wet tow.
Alternative Compartments
With compartment #2 unable to be deballasted without j-tube repair, an alternative was considered to deballast or remove weight from the lower end using another compartment of the RTM. **Table 3-5** outlines the status of the RTM compartments as at March 2019. As deballasting compartment #3 was already required to obtain less than 9.5 m draft, removal of ballast from compartment #1 is the only alternative to compartment #2 deballasting to achieve a similar draft. The iron ore will have settled on the bottom of compartment #1. The heavy iron content in the iron ore ballast will have caused it to solidify into one large mass since its installation in 2006, thus making the effectiveness of drilling large holes on the underside of compartment #1 to drain the iron ore impractical. Removing this iron ore ballast would require complete removal of compartment #1 by cutting through the RTM structure, including the external wall and the j-tubes that run through the compartment. This would require use of cutting tools, including either a diamond wire saw or an ROV. The RTM diameter at compartment 1 is 5.6–8.1 m, exceeding the diameter of existing diamond wire saws, which have a diameter of up to 5 m. The alternative would be to cut using an ROV, which is a non-routine activity. An ROV may be able to cut through the external wall of the compartment (which has a 17.6 m circumference, and a steel thickness of 25 mm). However, while an ROV could cut through the external wall, it would not be able to reach the j-tubes in the centre of the

Deballasting RTM to a Horizontal Draft of Less than 9.5 m

Applicable to Option 1a, 1b and 1c

RTM, and therefore the compartment would remain attached via the j-tubes. Further, the conical shape of the compartment provides a complex shape to engineer a lifting arrangement for the over 400 tonnes of load, resulting in a low probability of successfully recovering the ballast and a high probability of having to allow the compartment to free-fall to the seabed 400 m below. rendering the compartment unrecoverable. Therefore removal of compartment 1 has not been further considered.

The second alternative for compartment #1 is to deballast the ~200 m^3 of water and replace it with pumpable buoyancy. However, pumpable buoyancy was discounted for the reasons indicated above. Replacing the water in compartment #1 with air was also considered; however, compartment #1 was never designed to be watertight—flapper valves were installed to allow free flow of displaced seawater as the iron ore ballast was installed thereby making deballasting of compartment #1 impractical.

Buoyancy Bags

Analysis was performed to determine the quantity of external retrofitted buoyancy that would be needed to overcome ballast to obtain a draft of <9.5 m. Eight 35 tonne air bags would be required to obtain a draft of around 8.7 m. **Figure 3-6** shows a typical arrangement of buoyancy bags around the bottom end of the RTM.

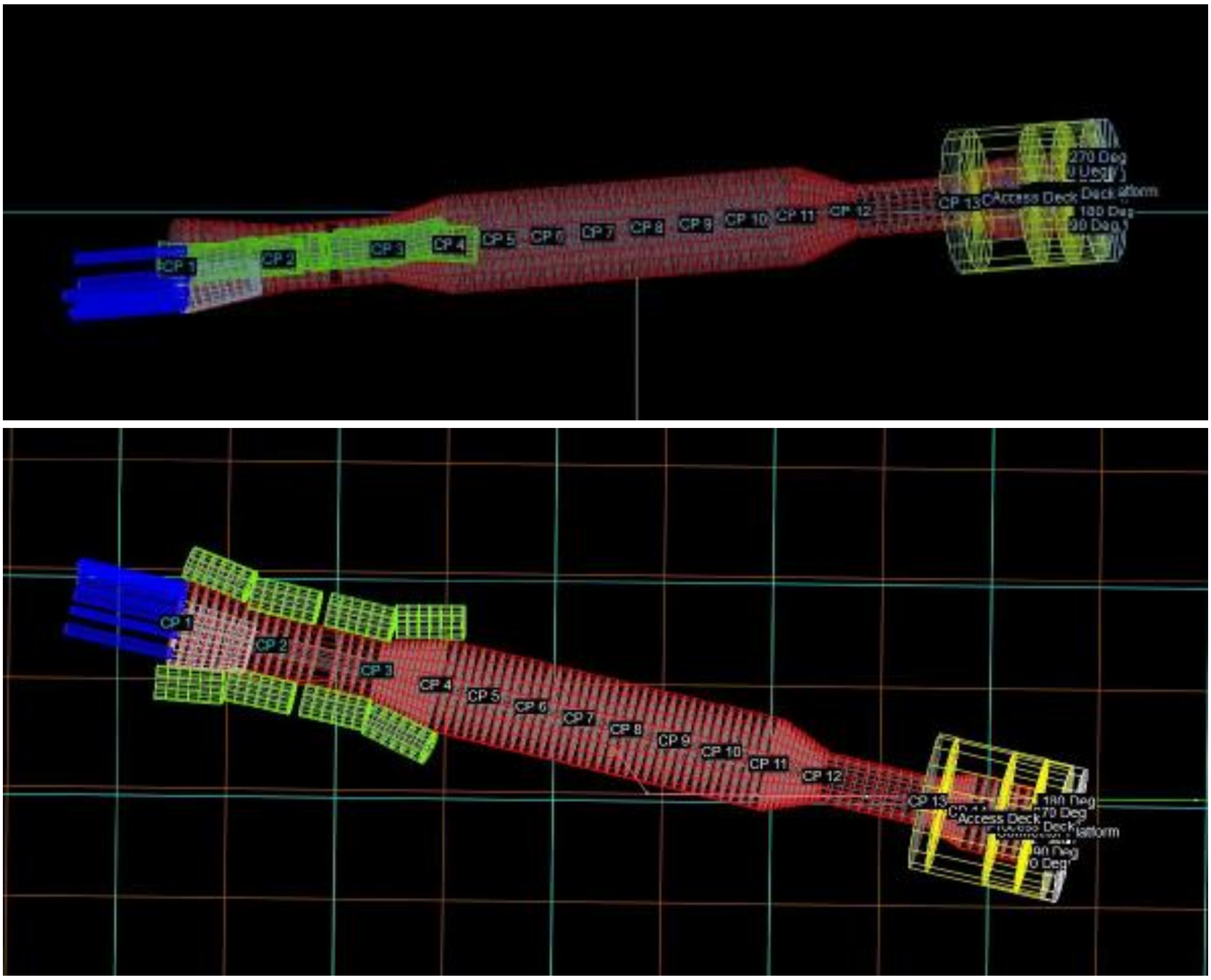


Figure 3-6: Typical buoyancy arrangement for RTM

Preference would be to use solid buoyancy to prevent unexpected leakage from inflatable buoyancy; however, practical installation of these large buoyant structures could only be achieved with the RTM horizontal on the surface, which cannot be achieved if buoyancy is used to get the RTM to horizontal. The alternative is attaching eight 35 tonne capacity deflated air bags subsea by ROVs and then conducting a staged inflation bringing the RTM to the surface. This is considered to have low technical complexity; however, keeping each of the 35 tonne air bags in position as the RTM is rotated after each inflation has a moderate probability of success. Further, the probability of all eight air bags successfully maintaining full buoyancy or remaining attached to the RTM until arrival at Henderson Port approximately

Deballasting RTM to a Horizontal Draft of Less than 9.5 m *Applicable to Option 1a, 1b and 1c*
1500 km away (4–5 week tow at slow ~1 knot speeds), or to sheltered water off Legendre Island ~550 km away (2-week tow at slow ~1 knot speeds), even at a low tow speed is considered low. A further consideration was made to first tow the RTM vertically to a location close to Henderson or Legendre Island then attaching the air bags to upend the RTM; however, the long vertical wet tow coupled with the complexity of attaching eight large 35 tonne air bags onto the RTM whilst in a suspended state (not moored to the seabed), then inflating in sequence whilst controlling the movement of the free-moving RTM with AHTs off the WA coastline, was considered to have an even lower probability of success.

Achievable Deballasting Draft with No-Repair (Semi-Horizontal) *Applicable to Options 1b, 1c and 1d (also suitable for 1e)*
With the high technical complexity and low probability of success of deballasting to a draft <9.5 m to achieve onshore disposal via the original plan at the contractor’s yard in Henderson, consideration was given to understanding the minimum achievable draft with a low technical complexity to support or improve success in medium to long wet towing of the RTM and/or lifting of the RTM.
Achievable Draft with No Repair
The shallowest draft of the RTM at keel with no repair and deballasting compartment #3 to around 9% full (practical maximum deballasting level) is around 29.5 m (34.5 m at riser tails). However, compartment #3 cannot be deballasted with the RTM in a near vertical state. To deballast compartment #3, air needs to be pumped into the air header pipework via deballasting hoses located on the top deck of the RTM. The air then enters compartment #3 at the top of the compartment pushing the water out through the water header pipework exit at the bottom of the compartment which then travels up to the RTM upper deck. Therefore, the head pressure is the distance between the bottom of compartment #3 and the highest point in the pipework/hosing. From RTM design drawings and contractor deballasting hosing arrangements during the original RTM removal campaign, this is confirmed to be a distance of 65–66 m, equating to 660 kPa(g) of water head pressure. Compartment #3 has a common air header with compartments #4 and #6 through to #11. During 2017 testing, compartment #4’s air header valve was identified to be in the stuck open position, therefore any air pumped into the common air header would also enter compartment #4. After the air header valve in each compartment there is a pressure relief valve (PRV) in the pipework that allows excess pressure to be automatically vented from the compartment. The PRVs in each of the compartments vent to common pipework, which in turn is open to the central shaft and to compartment #14. The intent of this common vent header arrangement was to equalise any differential pressure between compartments during the various stages of transport, installation and operation. Compartment #3 and compartment #4 PRVs are set at 811 kPa(g) and 753 kPa(g) respectively. From design drawings these PRV have an accuracy setting of +/-10%. Hence the relieving pressure would be in a range from 730–892 kPa(g) for compartment #3 and 678–828 kPa(g) for compartment #4. As compartment #4’s air header valve is stuck open the maximum pressure that can be applied to compartment #3, and therefore to compartment #4, via the stuck open valve is limited by the lowest relieving pressure of compartment #4 PRV which is 678 kPa(g). To obtain a reasonable and continuous flow during deballasting, a pressure of at least 100 kPa(g) [1 Bar(g)] over the head pressure is required, however the margin between head and potential PRV relieving pressure is only around 18 kPa(g) [0.18 Bar(g)]. Further, the vent into compartment #14, which was open and has no valving by design, was plugged just before FPSO disconnection to remove the possibility of flooding the RTM central shaft during horizontal tow to shore. To allow it to vent and not over pressurise the central shaft or compartment #14, confined space entry into compartment #14 would need to be undertaken to remove the plug. Although it may be technically feasible to remove the plug, reinstating it after RTM rotation to again mitigate the potential to flood the central shaft is not considered feasible. Therefore, despite the technical complexity being low, the probability of success in deballasting compartment #3 when the RTM is in a near vertical state is considered low. To potentially improve feasibility in deballasting of compartment #3, free flooding compartment #11 to partially rotate the RTM and reduce head to deballast compartment #3 was considered. However, flooding compartment #11 before any other compartments in the lower section are deballasted does not provide any upending/rotation of the RTM, instead just increasing the RTM vertical draft which does not reduce the head pressure to deballast compartment #3. ***Summary*** Given the above, the ability to upend the RTM to at least a semi-horizontal state without compartment #2 j-tube repair, use of pumpable buoyancy, buoyancy bags or use of compartment #1 (all of which are discussed in the previous section), is considered infeasible.

RTM Structural Capacity *Applicable to Options 1c and 1d*
Analysis was performed on a number of lifting configurations to determine the structural limits of the RTM; these credible lifting configurations were analysed: • RTM horizontal lift • RTM vertical lift (Aegir vessel used as reference). The lift analysis was based on all but compartment #1 ballast water to be allowed sufficient time to drain before lifting from the surface of the water resulting in a static load of 2142 tonnes being considered for the analysis. If the analysis proved a good margin in structural capacity, further analysis to include ballast water in other compartments into the lift analysis would to be conducted.
Horizontal Lift RTM Structural Check – HLV Dual Crane (Option 1c)
For a dual crane (twin lift) horizontal lift, the base analysis concluded that when applying a standard material utilisation factor or 0.6 yield stress (Fy) and a dynamic amplification factor (DAF) of 1.15 an overstress occurred on the structure. Even when removing the DAF an overstress occurred. In accordance with recommended practice technical guidelines for Marine operations during removal of offshore installations (DNVGL-RP-N102), a less stringent criteria may be used for structures that are to be scrapped after removal. Using a higher utilisation factor of 0.8 Fy and a DAF of 1.15 provides a marginally acceptable stress utilisation of 0.97, with 1.0 being the limit of acceptability. Further analysis to consider compartment #2 and/or compartment #3 being flooded during the lift was not pursued due to the limits derived from the base case, resulting in a limiting lift case for horizontal lift with all but compartment #1 deballasted and in maximum sea states that limited dynamic loading to 1.15 times the load. The above coupled with possible structural anomalies (cracks, corrosion, fabrication defects etc.) in the riser column may result in a further increase of utilisation and global structural failure; although not technically complex, the small margins result in lifting the RTM having a moderate-low probability of success.
Vertical Lift RTM Structural Check – Single Crane (HCV dual block) (Option 1d)
In a vertical lift from the water, the initial stages of the lift would see the entire load (minimum 2142 tonnes) of the RTM, including any residual ballast, going through a single point on the RTM. The FPSO connection point on the top of the RTM is rated for 1500 tonnes and hence cannot accommodate the full load at any stage. Therefore, the lift would need to be from the bottom of the RTM using a specifically designed subsea “donut” lifting arrangement installed to rest on the tapered sides of the lower section of the RTM. Preliminary analysis of this area and supporting structural elements indicate this may be suitable to accommodate the full RTM load. However, at some point in recovery to the vessel the RTM will need to be rotated to horizontal to land onto the deck of the vessel. Therefore the horizontal lift constrains, as previously described, would apply resulting in this lifting method not only being technically complex but having a moderate-low probability of success.

Suitable Sheltered Water Locations *Applicable to Options 1b and 1c*
When considering removal of the RTM from the water onto to a vessel for transportation to shore, the sea conditions for the lift were the foremost consideration. All heavy lift options generally use a DAF of 1.15 which equates to a sheltered calm water location or an indicative sea state of around 0.5 m significant wave height (Hs) possibly extending up to 1.0 m Hs. At the current RTM location in the title area, from historical exceedance data between 1979 to 2012, the sea state exceeds 1.0 m Hs 99% of the time, therefore, alternative locations were identified with the potential to provide suitable sea states for a successful lift.
Exmouth Gulf
When first installed in 2006, the RTM was transported by HLV to Exmouth Gulf and offloaded by the HLV before being wet towed horizontally ~85 km to the Enfield location (**Figure 3-7**). When offloaded from the HLV the RTM did not have the 325 tonnes of iron ore ballast, nor the 205 tonnes of ballasting water in compartment #2 resulting in a static lift of 1523 tonnes. Therefore, Exmouth Gulf was a primary consideration when identifying suitable lifting locations for the RTM either on a semi-submersible vessel or onto an HLV.

Suitable Sheltered Water Locations

Applicable to Options 1b and 1c

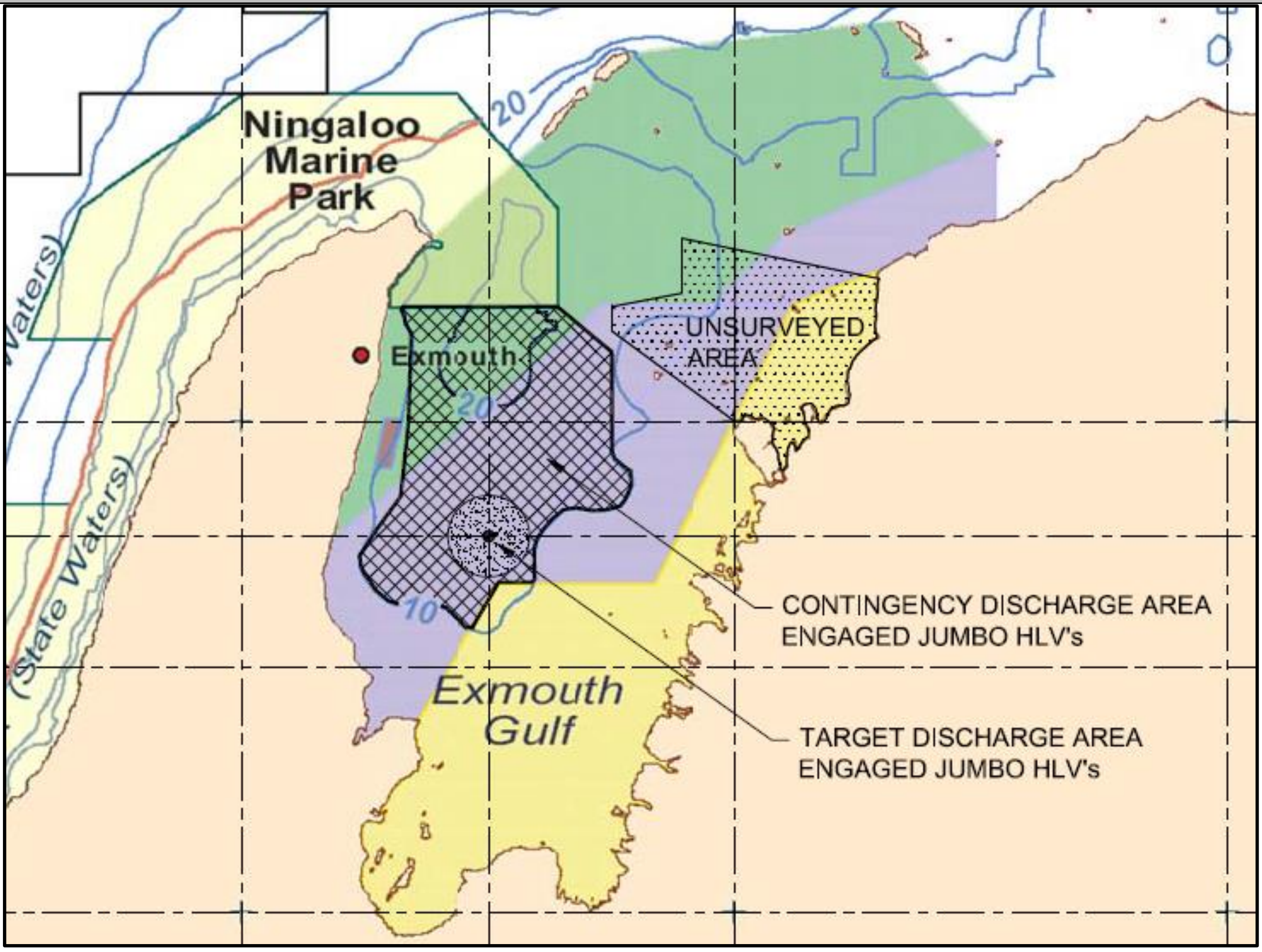


Figure 3-7: RTM offloading location for installation (2006 map extract)

The probability of obtaining a suitable sea state in Exmouth Gulf, due to historical heavy lift operations, was considered moderate. Current marine charts indicate the water depth at the 2006 offloading location is around 13–14 m lowest astronomical tide (LAT) with tidal variances of 2.3 m. Entering the Exmouth Gulf would see equal or marginally deeper water depths. Given this, Exmouth Gulf is too shallow for a semi-submersible (option 1b), which has a greater depth requirement to allow the vessel to submerge.

Summary

Exmouth Gulf appears to be technically suitable for an HLV loadout provided excess mooring chain remaining on the RTM is limited to prevent dragging on the seabed as it reaches shallower water in the gulf (refer to section preparation works above). Given this, use of Exmouth Gulf as a sheltered water location for removal of the RTM from the water is considered technically suitable for an appropriately sized HLV, however this location is subject to a number of seasonal environmental sensitivities.

Legendre Island

The closest identified alternative location to Exmouth Gulf with potentially suitable shelter and draft for both a semi-submersible and an HLV is behind Legendre Island, located around 330 km (direct line) north-east of the current RTM location.

Balnaves RTM was removed from the water in 2016 using an HLV in a location behind Malus Island close to Legendre Island; however, this location is not preferred for a HLV lift as there are numerous shipping lanes nearby and it is too shallow for a semi-submersible. However, this historical information gives a level of confidence that suitable sheltered water is potentially available in this area. Note: The Balnaves RTM was only approximately 3 years old, able to be deballasted to horizontal without any repairs, could be towed without risk of repair failure, and the lift was considerably lighter due to removable ballast reducing the lift to about 1150 tonnes static weight compared to Enfield RTM of calculated static weight around 2529 tonnes.

Historical exceedance data for the area behind Legendre Island accumulated between 1979 and 2019 indicate an 80–90% exceedance on 0.5 m Hs (significant wave height) down to a 10–20% exceedance on 1.0 m Hs. This means,

Suitable Sheltered Water Locations *Applicable to Options 1b and 1c*
depending on the sensitivity of the lift there may be a reasonable period waiting on a suitable weather window; however, a weather window is expected. ***Summary*** Use of Legendre Island as a sheltered water location for removing the RTM from the water is considered technically suitable for an appropriately sized HLV or semi-submersible; however, this option is subject to sea conditions.

Wet Towing *Applicable to Options 1a, 1b, 1c, 1e, 2a and 2c*
Horizontal Wet Tow to Henderson – Applicable to Option 1a
The original RTM disposal plan was to wet tow the RTM horizontally to a contractor’s yard in Henderson for disposal. Marine experts and the original planned RTM removal documentation estimate an average wet tow speed of the RTM in a horizontal orientation to be up to 2.0 knots in sea states up to 2.5 m Hs (normal conditions). Sea states above this would extend tow duration. With the journey to Henderson being around 1500 km, the non-stop duration of the tow is expected to be 2–3 weeks under normal weather conditions. Towing to Henderson would require the RTM to be repaired and deballasted to the horizontal. How this is achieved, the technical complexity and probability of success to achieve an RTM in a horizontal state ready for tow is covered in earlier sections. During the long tow to Henderson, the RTM would experience continuous flexing in the varying sea states expected to occur during the 2–3-week tow, inducing loads through the various rigid grout plugs which could compromise the seals to compartment #2. Further, the flexing could lead to fatiguing of critical welds such as the j-tube to compartment welds, increasing likelihood of weld failure and further possible leak paths. Considering the distance and duration of the tow, the probability of all grout plugs remaining intact and compartment #2 remaining sealed at the end of the tow to Henderson, such that no additional leak paths are created and suitable draft is maintained to allow the RTM to be loaded onto the Syncro-Lift, make this tow option a low probability of success. Further, if during the tow the RTM begins to lose draft there is little if anything that can be done to stop the partial or full sinking of the RTM. ***Summary*** Wet towing a repaired RTM to Henderson, and being able to load onto the Syncro-Lift is considered to have a moderate technical complexity and a low probability of success.
Horizontal Wet Tow to Legendre Island – Applicable to Option Option 1b and 1c
To bring the RTM to the Legendre Island sheltered calm water lifting location avoiding all subsea and surface infrastructure would result in a tow of around 480–500 km (**Figure 3-8**).

Wet Towing

Applicable to Options 1a, 1b, 1c, 1e, 2a and 2c

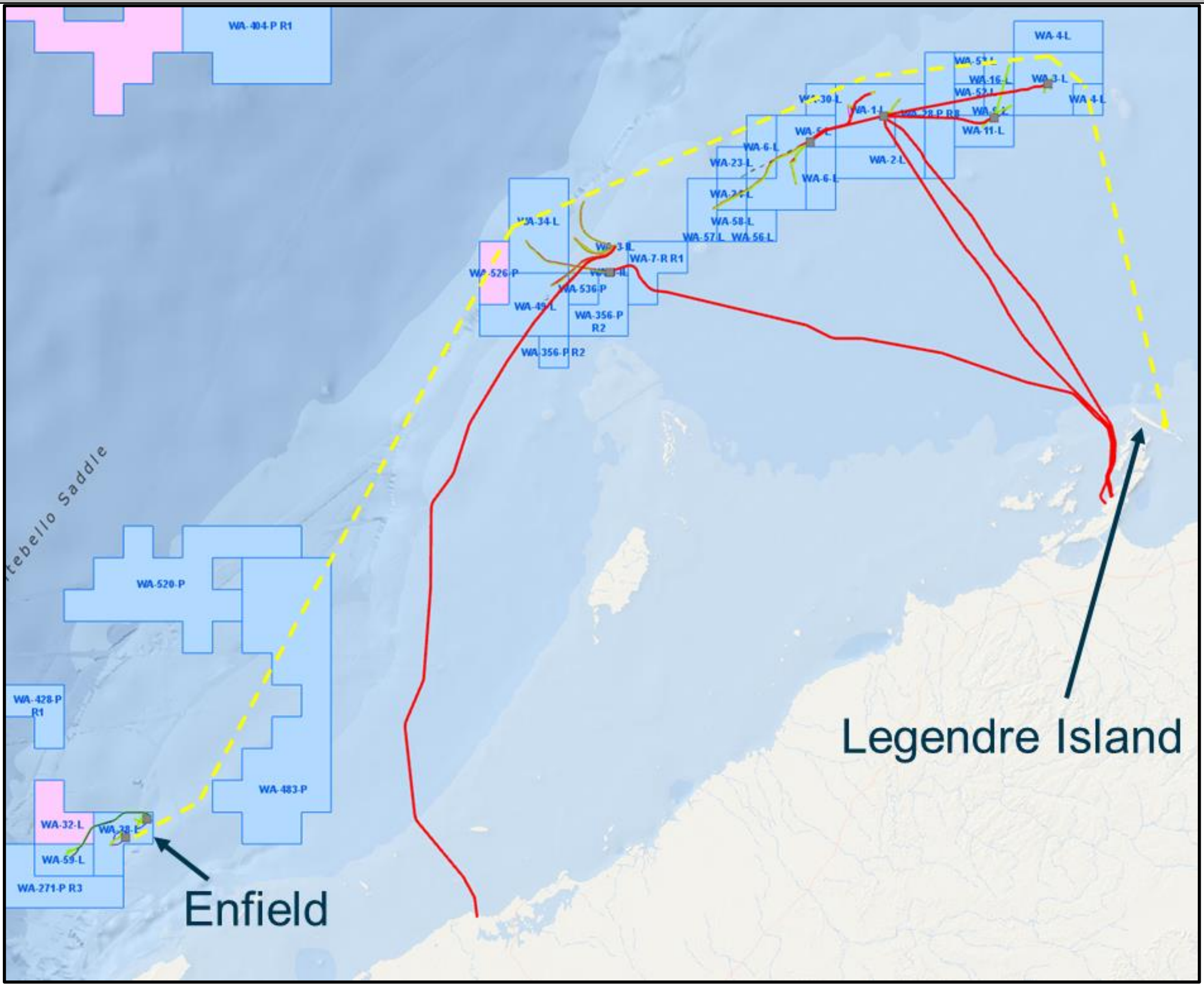


Figure 3-8: Tow route from current location of RTM to sheltered waters near Legendre Island

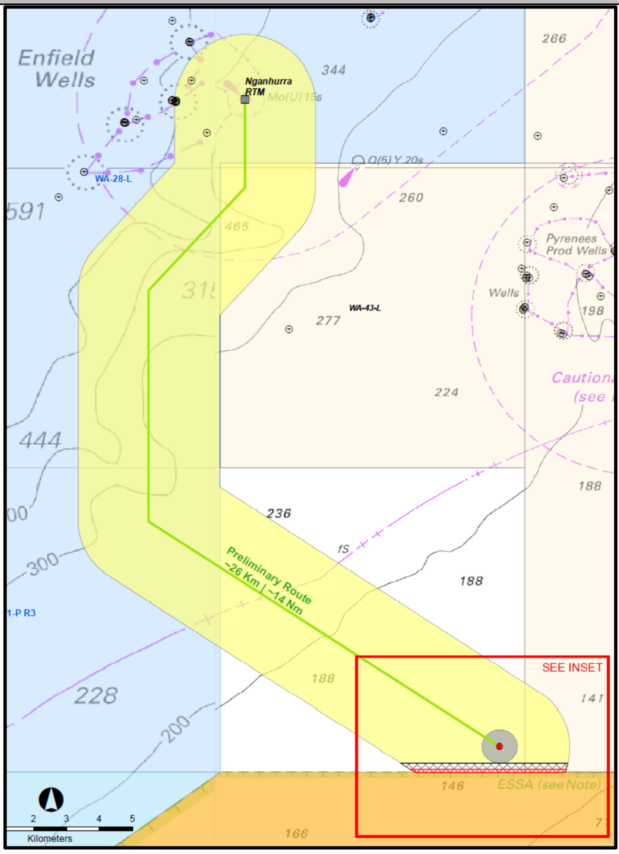
Marine experts and the original RTM installation documentation provides an estimate the average wet tow speed of the RTM in a horizontal orientation to be up to 2.0 knots in sea states up to 2.5 m Hs (normal conditions); seastates above this will extend tow duration. With the journey being around 500 km, the non-stop duration of the tow is expected to be 7–10 days under normal weather conditions.

The water depth at the sheltered water location will be about 20–30 m, meaning the RTM will need to be in a horizontal orientation when arriving at the sheltered calm water location and would need to be repaired before disconnecting it from its moorings. How this is achieved, the technical complexity and probability of success to achieve an RTM in a horizontal state ready for tow is covered in earlier sections. During the tow the RTM would experience continuous flexing in the varying sea states expected to occur over the 7–10-day tow, inducing loads through the various grout/mechanical plugs which could compromise the seals to compartment #2, resulting in a low probability of arriving at the sheltered location with suitable draft to conduct the recovery operations by HLV or to semi-submersible (as described in later sections).

As the tow route occurs in the cyclone region of WA, an event where the AHT(s) have to disconnect from the RTM in an active cyclone emergency, must be considered. If this occurred, the RTM would be uncontrolled until the AHTs could reconnect and continue the tow. If the RTM experienced excessive sea conditions due to a cyclone then it is highly probable that the grout/mechanical plugs would be damaged/lose seal, with compartment #2 fully flooding again. Although this may not cause the RTM to fully sink it would result in the RTM ballasting to a semi-horizontal orientation preventing the semi-submersible or HLV lift from proceeding without re-repairing the RTM at Legendre Island.

Gaining access to the j-tubes to remove the repair grout or mechanical plugs is technically complex and possibly impractical for ROVs due to the shallow water depth the works would be performed in. Where access is possible, the grout within the j-tubes would then need to be water jetted or drilled out and the j-tubes cleaned. It would be impossible to capture the grout wash escaping from the j-tubes as the grout is removed. Grout removal would take weeks with a low probability of successfully removing sufficient grout to reseal the j-tubes. Further, personnel would need to access

Wet Towing *Applicable to Options 1a, 1b, 1c, 1e, 2a and 2c*
the top of the RTM to attach deballasting hoses and the deballasting effectiveness of compartment #2 would depend on the orientation of the RTM because of where the inlet ballast pipework is located in relation to the water outlet pipework within compartment #2. The probability of achieving a suitable deballast volume to provide the required draft is very low, therefore, is considered technically impractical. ***Summary*** Wet towing a repaired RTM to sheltered water behind Legendre Island and maintaining draft to allow loading onto a semi-submersible or HLV lift is considered to have moderate technical complexity and a low probability of success.
Partial Horizontal Tow to Deep Water Port – Applicable to Option 1e
A deepwater port option for onshore disposal was considered based on the potential for the RTM to be partially deballasted to between 18.1 and 22.5 m draft at the riser tails. Various ports were reviewed within a 7000 km radius of the RTM's current location, with the closest accessible port with draft of around 20 m being Batam, Indonesia ~3000 km away. ***Summary*** With a tow duration exceeding 5 weeks (at average of 2 knots and normal sea conditions) and the high probability of the tow being impacted by poor weather, this option is considered to have a very low probability of success.
Vertical Wet Tow to IAR Location – Applicable to Option 2a
The proposed IAR location was identified based on consultation by Recfishwest with the recreational fishing community in Exmouth, and a constraints mapping process. The constraints mapping process was undertaken to ensure that the proposed location is compatible with the purpose of the artificial reef, and includes considered feedback from the local recreational fishing community, as well as suitability based on aspects such as the location of marine parks, shipping, anchorages and channels and areas for defence activities. The key constraints for selection of a suitable location were: • outside State and Commonwealth marine parks • minimum 80 m water depth (due to RTM being towed in a vertical position) • maximum 200 m water depths. Feedback from the Recfishwest consultation process (**Section 5**) unanimously supported the identified proposed location based on site accessibility, water depth and access to fishing opportunities. The proposed IAR location is about 26 km from the current location of the RTM (**Figure 3-9**).

Wet Towing *Applicable to Options 1a, 1b, 1c, 1e, 2a and 2c*
 **Figure 3-9: Tow route from current location of the RTM to identified IAR location** Marine experts and potential subsea contractors estimate an average tow speed of the RTM in a vertical orientation to be up to 1.5 knots in sea states up to 2.5 m Hs (normal conditions). Sea states above this will not be considered due to the short distance of the tow, and the last mooring leg(s) of the RTM would not be disconnected/cut until a suitable declining weather window is forecast for the tow. With the journey being around 26 km, the non-stop duration of the tow is expected to take 6–12 hours. As the RTM is not being repaired prior to the tow there is no concern for repair works failing. ***Summary*** Vertically wet towing the non-repaired RTM to the IAR location is considered to have low technical complexity and a high probability of success.
Vertical Wet Tow to Deep Water Sea Disposal Location – Applicable to Option 2c
A deepwater sea disposal option was considered, with a location identified in ~2000 m of water. The identified location is ~370 km from the current location of the RTM (**Figure 3-10**).

Wet Towing

Applicable to Options 1a, 1b, 1c, 1e, 2a and 2c

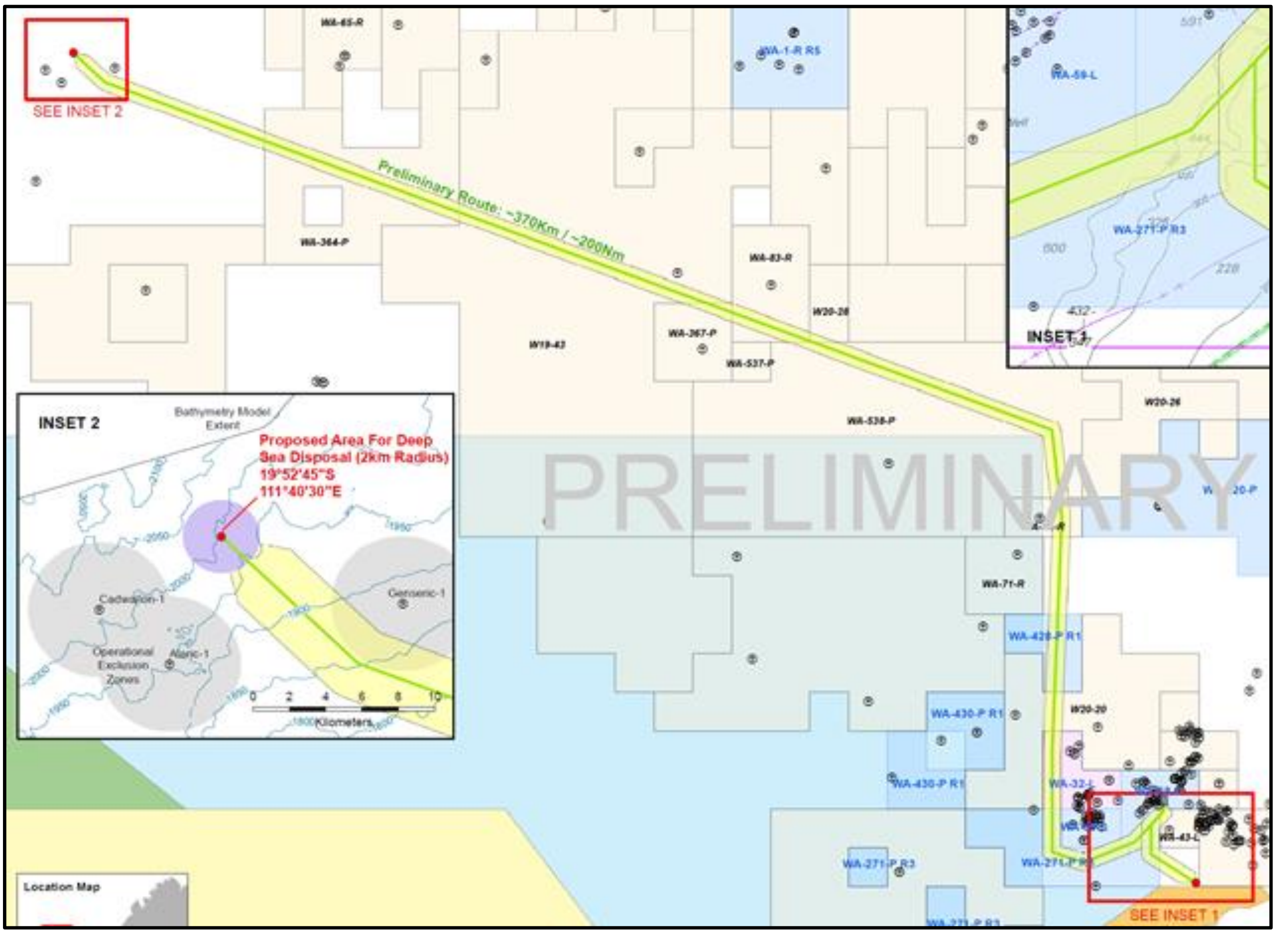


Figure 3-10: Tow route from current location of the RTM to identified offshore deepwater disposal location

Marine experts and the original planned RTM removal documentation estimate the average tow speed of the RTM in a vertical orientation to be up to 1.5 knots in sea states up to 2.5 m Hs (normal conditions). Sea states above this will extend tow duration. With the journey being around 370 km the non-stop duration of the tow is expected to take 5–6 days under normal weather conditions.

As the tow route occurs in the cyclone region, an event where the AHT(s) have to disconnect from the RTM in an active cyclone emergency, must be considered. As the RTM is not planned to be repaired for this option the concerns around grout/mechanical plugs are not applicable for this option and it is expected that the RTM would be reconnected, brought to the deepwater locations and sunk.

Summary

Vertically wet towing the non-repaired RTM to the deepwater sea disposal location is considered to have a moderate-high probability of success.

RTM Refloat or Crane Lift

Applicable to Options 1b, 1c and 1d

Semi-submersible Vessel Lift – RTM Refloat – Applicable to Option 1b

When considering removal of the RTM from the water using a semi-submersible vessel to refloat the RTM onto the vessel's main deck a number of key constraints were identified.

The largest semi-submersible in the world has a main deck draft of 15.5 m (vessel draft is 31.5 m when submerged). To accommodate the RTM onto the semi-submersible main deck and safely transport the RTM to an onshore location, the RTM would need to rest in, and be seafastened in, pre-fabricated cradles. Cradles are expected to be at least 1 m high,

RTM Refloat or Crane Lift *Applicable to Options 1b, 1c and 1d*

hence available draft would be reduced to 14.5 m then, considering a float-over clearance of at least 0.5 m, the maximum available draft is no more than 14 m to the deepest part of the RTM.

Smaller, more readily available semi-submersible vessels generally have a main deck draft of around 12 m (vessel draft of about 22–28 m when submerged), hence available draft for RTM float-over would be around 10.5 m if using a smaller vessel. The potential added benefit of a smaller vessel may be to allow the vessel to come closer to shore to obtain improved shelter; however, this is expected to offer marginal if any improvement.

Without compartment #2 j-tube repair, use of pumpable buoyancy, buoyancy bags or use of compartment #1 (all of which are discussed above), the RTM cannot be deballasted to a suitable draft for refloating by a semi-submersible. For the purposes of evaluating the remaining technical factors of this option the deballasting is assumed feasible, although as described previously this has high complexity and low probability of success.

To accommodate the float-over operation involves the semi-submersible vessel and at least two AHTs and sheltered calm sea states, which equates to a indicative sea state of around 0.5 m Hs and possibly up to 1.0 m Hs. Suitable sheltered water locations to perform this operation are discussed previously and confirm that refloat operations could be undertaken behind Legendre Island.

Summary

A reasonable time waiting for a suitable weather window may occur; however, the probability of successfully obtaining a suitable weather window to float the RTM on to a semi-submersible is moderate to high with moderate technical complexity. This probability of success does not include a cyclone event occurring that directly impacts the sheltered water location.

Transport Heavy Lift Vessel (HLV) – Dual Cranes – Applicable to Option 1c

When considering removal of the RTM from the water using a dual crane transport HLV to lift the RTM from the water onto its deck or onto a barge, the maximum lifting capacity of HLV cranes was identified as a key constraint and hence the technical feasibility of this option focused on this area. The calculated heaviest load in lifting the RTM from the water is at the point when the RTM is lifted clear of the water as this is when all buoyancy, provide by the empty compartment voids, is negated and the weight of the RTM construction material and any water trapped within the RTM becomes a load applied on the crane hooks. The calculated heaviest expected load has been determined from as-built weight reports. **Table 3-11** summarises the main weight elements that make up the load on the crane hooks.

Table 3-11: RTM out of water weight summary

Item	*Mass (tonnes)*	*Contingency*
Dry weight	1422.7	20
Concrete keel	80.64	0
Solid ballast in compartment #1	325.1[1]	10
Water in compartment #1	205.18	0
Riser sections	109[2]	5
Water in compartment #2	222.7[3]	0
Water in compartment #3	123.37	5
Net weight at exit from water	2488.69	40
Calculated static load *(weight plus contingency)*	2529	
Calculated dynamic load *(includes heavy lift applicable DAF x 1.15)*[4]	2908[5]	

[1] Estimated weight by draft calculation at time iron ore ballast was installed.

[2] Estimate includes full length of remaining riser sections, bend stiffeners and bend stiffener connectors.

[3] Weight assumed at moment RTM is lifted clear of water and compartment #2 is still fully flooded but commencing to flow out of j-tube hole(s).

[4] The DAF of 1.15 is for a sheltered calm waters lift.

[5] Excludes any allowance for marine growth weight.

By analysis, the centre of gravity (CoG) of the RTM in the air when horizontal is about 9.9 m offset from the middle of the RTM due to the iron ore ballast, concrete keel and water ballast of compartment #1, totalling 610 tonnes. When including the water ballast in compartment #3 (123 tonnes) and, if the RTM is just lifted clear of the water, including compartment #2 ballast (222 tonnes) then the CoG becomes further offset towards the bottom of the RTM. Further, as the water drains from compartment #2 via the voids in the j-tubes then the CoG will move back towards the centre of the

RTM Refloat or Crane Lift *Applicable to Options 1b, 1c and 1d*

RTM, thus moving some of the load between crane hooks making the lift technically complex and reliant on adequate margins on crane capacities.

The largest identified HLV in the world has a combined dual crane capacity of 3000 tonnes with each crane having an equal lifting capacity of 1500 tonnes. With an equal split load of 2,908 / 2 = 1,454 tonnes, this would result in each crane being at 97% capacity.

Summary

Within only a 3% margin on crane capacity limits and considering the need to cater for margins of error including erroneous waves, weight estimates, CoG calculations and the expected movement of CoG during the lift, it is concluded that lifting using an HLV has high technical complexity and a low probability of success.

As there is no other identified HLV with higher capacity cranes, the only potential to use an HLV with the dual cranes of 1500 tonnes each capacity would be to reduce the lift load. The only method of achieving this is to remove water ballast from the RTM before the lift and this would require RTM repair as described in previous sections. **Table 3-12** summarises the main weight elements that make up the load on the crane hooks where the RTM has been repaired and deballasted prior to lift.

Table 3-12: RTM out of water weight summary (repaired)

Item	*Mass (tonnes)*	*Contingency*
Dry weight	1422.7	20
Concrete keel	80.64	0
Solid ballast in compartment #1	325.1[1]	10
Water in compartment #1	205.18	0
Riser sections	109[2]	5
Water in compartment #2 (2% remaining)	**4.5**	**1**
Water in compartment #3 (9% remaining)	**18.5**	**2**
Net weight at exit from water	2165.6	38
Calculated static load *(weight plus contingency)*	2,204	
Calculated dynamic load *(includes heavy lift applicable DAF x 1.15)*[4]	2,534[5]	

[1] Estimated weight by draft calculation at time iron ore ballast was installed.

[2] Estimate includes full length of remaining riser sections, bend stiffeners and bend stiffener connectors.

[3] Weight assumed at moment RTM is lifted clear of water and compartment #2 is still fully flooded but commencing to flow out of j-tube hole(s).

[4] The DAF of 1.15 is for a sheltered calm waters lift.

[5] Excludes any allowance for marine growth weight.

The above calculated dynamic load would mean that with an equal split of load 2,534 / 2 = 1,267 tonnes this would result in each crane being at 84% capacity.

Summary

With a remaining capacity of around 16% to accommodate a margin for error including for erroneous waves, weight estimates, CoG calculations and the movement of CoG during the lift, this option is considered to have moderate technical complexity and a moderate probability of success.

Heavy Construction Vessel (HCV) – Single Crane Vertical Lift (dual block) – Applicable to Option 1d

The single crane vertical lift (dual block) option, would involve lifting the RTM vertically from the water at its current location and without repair, rotating the RTM using a split block arrangement and landing the RTM on the back deck of the HCV. However, in the split block arrangement (**Table 3-12**) the static load would exceed the 2000 tonne capacity of one of the crane blocks when the RTM is suspended in the fully vertical orientation and the dynamic load continues to exceed the block capacity during onset of load transfer (analysed at 10 degrees from vertical) to the second crane block as the RTM is rotated. At 45 degrees from the vertical, the split blocks angle exceeds the 40 degree limit (analysed to be ~50 degrees) and the dynamic load on one crane block is also exceeded.

Consideration was made to performing the rotation in the water thereby reducing the load considerably before horizontal lift from water; however, the limit on crane block angle would heavily constrain this option.

Summary

RTM Refloat or Crane Lift *Applicable to Options 1b, 1c and 1d*
High technically complexity and a low probability of success. Similar to the semi-submersible and HLV, the HCV needs calm sea states to limit dynamic loading and be able to control movement/swing of the RTM once clear of the water. With a DAF of 1.15 being used for heavy lifts this equates to an indicative sea state of around 0.5 m Hs, possibly up to 1.0 m Hs. Historical exceedance data for the Enfield area accumulated between 1979 and 2012 indicates a 100% exceedance of 0.5 m Hs and 99% exceedance of 1.0 m Hs. ***Summary*** Therefore, obtaining a suitable weather window to perform lifting in field with a limiting sea state of up to 1.0 m Hs has a very low probability of success.

RTM Topsides Preparation Work *Applicable to All Options*
Under all options topsides work on RTM is unavoidable; however, the extent of work varies depending on each option. Transfer of personnel to the RTM has low technical complexity and a high probability of technical success.
Removal of Topsides Miscellaneous Items – Applicable to All Options
All draft monitoring, temporary protective equipment and miscellaneous materials will be removed before disconnecting the RTM from its moorings. ***Summary*** As the duration to complete this scope is short, about one day, transfer of personnel and execution of these works has low technical complexity and a high probability of technical success.
Removal of Navigation Aids – Applicable to All Options
The navigation aids on the RTM will be removed following any towing of the RTM. ***Summary*** The original navigation aids were removed and replaced with ROV-removable aids to facilitate low technical complexity and high probability of success in removing them after sinking the RTM.
Removal of Topsides Plastics and Chemicals – Applicable to all Offshore Options (2a, 2b and 2c)
For options where RTM is to be repurposed or disposed offshore, plastics and chemicals are to be removed. This includes removing electrical cables and hoses, flushing hydraulics and chemicals, and decanting the drain pot. All plastics and chemicals would be recovered to the installation vessel for onshore disposal, except those chemicals in the umbilical, which would be flushed to the marine environment as described in **Section 6.6.1.4.** ***Summary*** As the duration to complete this scope is short, around 2–4 days, transfer of personnel and execution of these works has low technical complexity and a high probability of success.

Bend Stiffener Removal *Applicable to All Offshore Options (2a, 2b and 2c)*
For options where the RTM is to be repurposed, or disposed offshore, the riser bend stiffeners are to be removed. This work requires ROV operations partially under but off to the side of the RTM, to install a diamond wire saw (DWS) onto the bend stiffener connector. Following installation, the DWS is activated and the wire cuts through the steel work holding the bend stiffener onto the j-tube. Detailed engineering is expected to determine a method of clamping the DWS onto this area; however, the clearance between the bottom of the RTM and the location the DWS would need to be clamped to perform the “target cut line” is constrained for ROV access hence is considered to have a moderate probability of success. A more suitable location for the cut allows the DWS to be clamped onto the cylindrical steel casing of the top of the bend stiffener, with a cut being performed ~400–500 mm below the start of the bend stiffener. However, this will leave some of the bend stiffener material on the RTM. Where this is the case the remaining bend stiffener materials will be encased in grout following the cut. ***Summary*** Although complete removal of the bend stiffener material by an ROV-operated DWS has moderate technically complexity due to the lack of space and profile of the area above the bend stiffener preventing direct clamping of the DWS (**Figure 3-11**), removing most of the bend stiffener material and grouting the remaining material is considered to have a low technical complexity and a high probability of success.

Bend Stiffener Removal *Applicable to All Offshore Options (2a, 2b and 2c)*

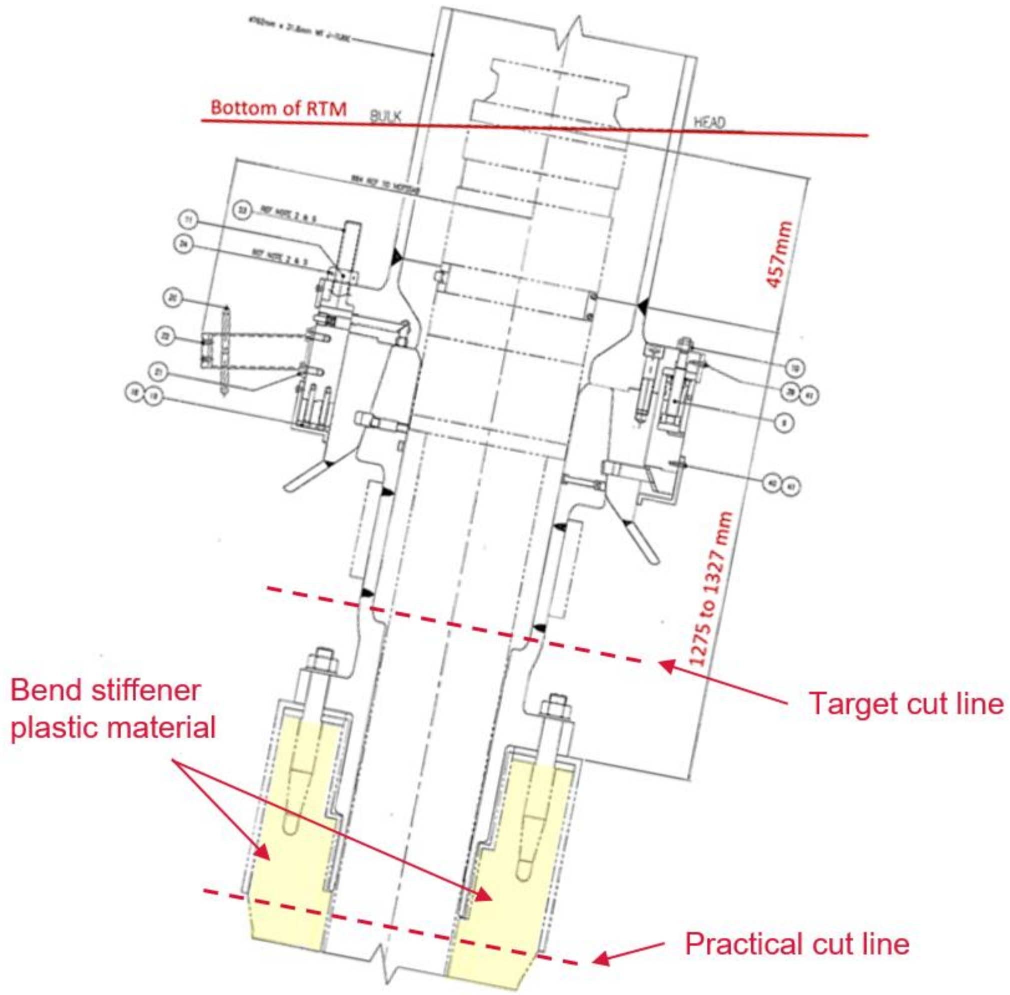



Figure 3-11: Feasibility of removing bend stiffeners from RTM

Risers Removal Works *Applicable to Options 1a, 1b,1c, 2a and 2c*
For options where the RTM is to be repurposed or disposed offshore, the flexible risers and dynamic umbilical (EHU) are to be removed where practicable. Two methods of removal are available to extract the flexible risers and dynamic umbilical (EHU) from the j-tubes in the RTM: • lowered out through bottom of the j-tubes (reverse of installation) • pulled out from the top of the j-tube. Both extraction methods were then considered in two different scenarios of when the RTM is: • moored in the field • on the seabed in a horizontal orientation.
Riser Removal via Bottom of J-tubes (RTM Moored) – Applicable to Options (1a, 1b and 1c)
To remove the flexible risers and dynamic umbilical in a 'reverse installation' method whilst the RTM is moored in the title area would require rebuilding and re-installing a large winch platform on top of the RTM to lower each riser down through each j-tube and out of the bottom. The bend stiffeners at the bottom of the j-tubes, which were pre-installed over the flexibles/umbilical at manufacture, are designed to hug the main body of the flexible riser and dynamic umbilical to prevent the end fittings (flexible head) of the risers from passing through inside the bend stiffener.

Risers Removal Works *Applicable to Options 1a, 1b,1c, 2a and 2c*
When originally installed, the bend stiffeners were attached to the bottom of the j-tubes via the bend stiffener connectors (**Figure 3-11**). Following discussions with the bend stiffener connector manufacturer, it is considered highly improbable that the hydraulically activated connector latching/de-latching mechanism will be functional after being in a marine environment for as long as the RTM has been to date. Hence the bend stiffener connectors and therefore the bend stiffeners cannot be disengaged from the j-tubes to allow removal with the risers. Further, if the bend stiffener connector could be cut as high as the "Target cut line" as described in the earlier section then this would still leave the connector mechanism connected to the j-tube. The flexible end fitting contains a mechanical retaining pin which would prevent the flexible end fitting from passing through the remaining bend stiffener connector, a safety measure for installation purposes. An alternative step to allow removal of the risers out the bottom of the j-tubes where the bend stiffener connectors cannot be removed/disengaged, would be to cut the flexible end fitting off and lower the risers down through the j-tubes, bend stiffener connectors, and the bend stiffeners. Securing the risers for a controlled lowering has low-moderate technical complexity, and would require an increase in topsides preparation work; however, it is considered to have a high probability of technical success. ***Summary*** Removal of the risers out the bottom of the j-tubes without cutting off the flexible end fittings is not considered feasible unless the flexible end fittings are cut off each riser; this is considered to have low-moderate technical complexity with a high probability of success.
Riser Removal via Top of J-tubes (RTM Moored) – Applicable to Options (1a, 1b and 1c)
With the constraints in removing the risers from the bottom of the j-tubes, as discussed above, removal from the top of the j-tubes was considered in the knowledge that each lower end of the flexibles and umbilical have been cut and free to pass through the bend stiffener assembly at the bottom of the j-tube. To remove the risers from the top of the j-tubes when the RTM is moored in the title area would involve using a PIV crane to lift the risers completely out in one pull or in cut segments. Using a winch system pre-installed on the RTM would not provide suitable head height for practical removal. Dynamic motions, from the environment conditions, between the installation vessel and the RTM could result in large uncontrollable movements of the risers as they are being pulled out of the j-tubes with the vessel crane; this movement cannot be completely mitigated. ***Summary*** This option is considered to have low technical complexity and a moderate probability of success.
Riser Removal via Top of J-tubes (RTM on Seabed) – Applicable to Options (2a and 2c)
An alternative method for removing flexible risers from the top of the j-tubes is to do the removal once the RTM is horizontal on the seabed. This eliminates RTM motion, thus limiting movement to the crane hook and/or winch system on the installation vessel. To remove the risers, the riser topsides hang-off assemblies would be prepared before the RTM is disconnected from its moorings, such that when on the seabed an installation vessel winch-based system or crane could be attached to a rigging assembly on the seabed to pull the risers directly out the j-tubes and then recover them to the surface onto the installation vessel. The probability of success for this option is slightly higher in the shallower water that is a feature of the IAR option. ***Summary*** This option is considered to have a low level of technical complexity with a high probability of success.

Technical Feasibility Assessment Conclusion

The main activities/steps assessed for each option described in the previous sections are summarised in the matrix below.

Option Activity	1a		1b		1c		1d		1e		2a		2b		2c	
	Henderson		Semi		HLV		HCV		Deep Port		IAR		Deep Water		Infield	
	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS
TOPSIDES WORK																
Personnel transfers to/from RTM	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
Misc. equipment and nav aids removal	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H

Option Activity	1a		1b		1c		1d		1e		2a		2b		2c	
	Henderson		Semi		HLV		HCV		Deep Port		IAR		Deep Water		Infield	
	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS	TC	PoS
Flush and removal of plastics											L	H	L	H	L	H
Riser removal preparation	L	H	L	H	L	H					L	H			L	H
Riser removal (RTM moored)	L	M	L	M	L	M										
SUBSEA WORKS																
Riser removal (on seabed)											L	H			L	M
Bend stiffener removal											L	H	L	H	L	H
METHODS TO DEBALLASTING TO HORIZONTAL (<9.5M DRAFT)																
J-tube repair	H	L	H	L	H	L										
Pumpable buoyancy	X	X	X	X	X	X										
Alternative compartments	X	X	X	X	X	X										
Buoyancy bags[1]	L	M	L	M	L	M										
Note 1: Buoyancy bags not considered suitable for tows therefore wet towing considers j-tube repair only.																
WET TOWING																
To Henderson	M	L														
To Exmouth Gulf			X	X	L	M										
To Legendre Island			M	L	M	L										
To deepwater port									M	L						
To IAR location											L	H				
To deep sea location													M	M/H		
Infield															L	H
STRUCTURAL CAPACITY																
RTM structural lift capacity (by crane)					M	M/L	H	M/L								
REFLOAT / LIFT																
Henderson Syncro-Lift	L	H														
Semi-submersible raising			M	M/H												
HLV lift					M	M										
HCV lift							H	L								

TC = Technical Complexity
PoS = Probability of Success
*For descriptions of the ratings for each activity refer to **Table 3-8** and **Table 3-9**.*

Schedule Assessment

Schedule has been used as a criteria to evaluate the options given the potential for the RTM to be a navigational hazard, or for the potential for the RTM to further lose buoyancy, which has potential to impact the feasibility of removing the RTM. A target schedule of removal of the RTM before the end of April 2021 has been used.

In its current location, the RTM is a potential navigational hazard for commercial shipping and other marine users, albeit a very low risk given the low shipping density in the area (**Section 4.4.1**).

Extended duration in the field also increases the potential for partial loss of buoyancy, which is expected to result in the RTM draft changing to between -5 m and 2.7 m. This would present a submerged or partially submerged hazard to other marine users. An additional two compartments would need to fail for this to occur, according to a detailed engineering assessment completed by a third party, with the full assessment provided in NOPSEMA Inspection Recommendation Closeout 2041-2.

The timing for the RTM removal is highly dependent on the prevailing metocean conditions, which can impact the accessibility of the RTM, and the ability to execute the work. Based on metocean conditions for the Enfield reservoir, potential weather windows for field execution exist only between December and April, and even during this period will be limited to days that meet vessel wave height criteria. An estimated schedule for each of the options and their ability to meet target removal by the end of April 2021 is presented in **Figure 3-12**.

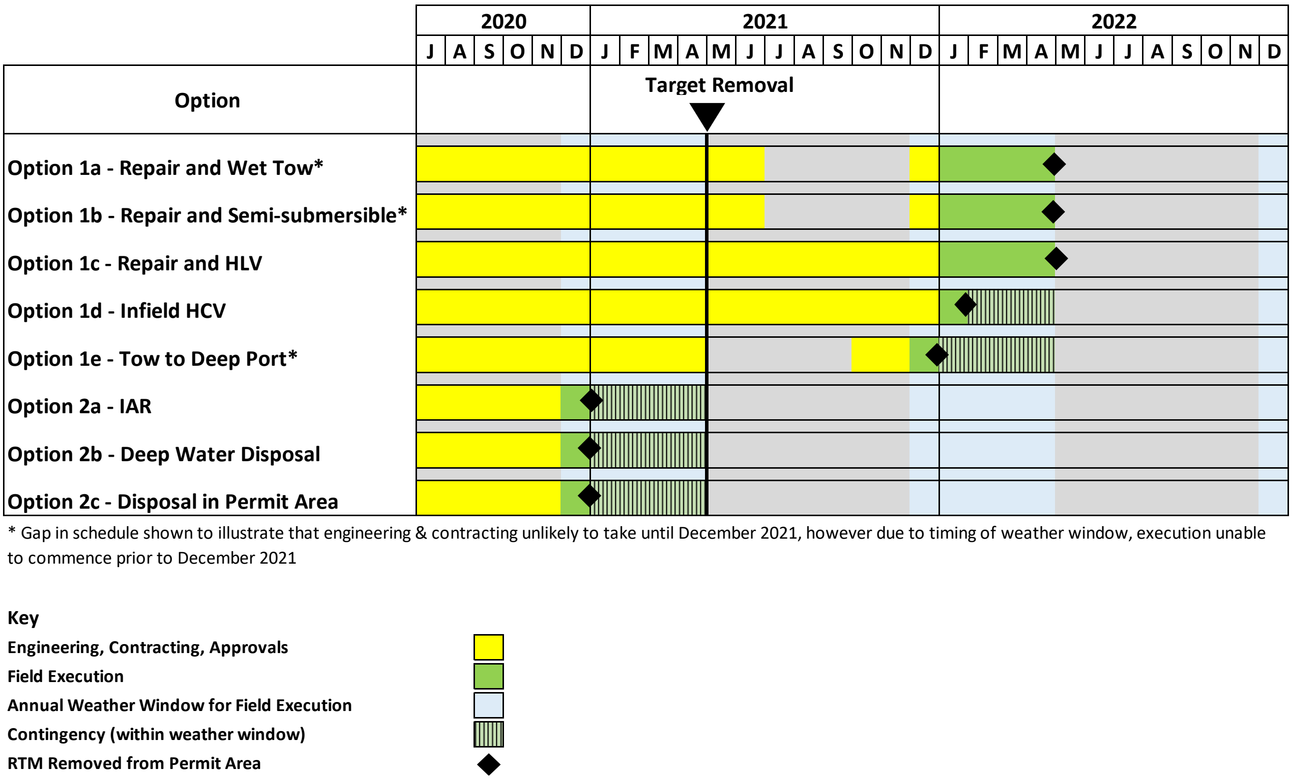


Figure 3-12: Estimated schedule for identified decommissioning options

Due to their high technical complexity, the onshore removal options have a longer schedule for engineering, contracting and approvals (including safety case), therefore none of these options are able to meet the removal target of April 2021 and would result in removal during 2022. Note: For options that require the RTM to be repaired, due to the duration of repair, there is no contingency time available in the schedule, resulting in a potential that the repair would require a second weather window to be completed. Offshore repurposing and disposal options have a shorter schedule for engineering and contracting relative to onshore disposal given their higher technical feasibility, therefore options 2a, 2b and 2c are able to meet the target removal timing.

Health and Safety Risk Assessment

A health and safety risk assessment was conducted to assess risks associated with each of the decommissioning options. Health and safety risks were evaluated based on key risks associated with removing the RTM for each of the options (**Table 3-14**). Risks that did not differentiate between options were not included in this assessment. The criteria used for the risk assessment are described in **Table 3-13**. Risks were ranked using the Woodside Risk Matrix.

Table 3-13: Health and safety risk assessment criteria

Health and Safety Risk Criteria	***Personnel transfers***	Safety risk associated with personnel transfers to/from the RTM via personnel transfer basket or pilot ladders. Personnel transfers were estimated based on the number of days expected to complete field operations.
	Lift of RTM failure	Safety risk associated with structural failure of the RTM during the lift or failure of the lift, resulting in dropped object.
	Diving	Safety risk associated with commercial diving, if required, particularly saturation diving due to the potential to lose air supply during the dive.
	RTM preparation/ repair	Safety risk associated with the full scope of work, including RTM preparation and repair and excluding specific activities that have been assessed separately (personnel transfers, RTM lift, diving, towing of the RTM and removal of the risers). This includes dropped objects on the RTM.
	Ship collision during tow	Safety risk associated collision with third-party vessel during tow.
	Riser removal with RTM on seabed	Safety risk associated with recovery of risers

Table 3-14: Health and safety risks associated with RTM removal options

	Onshore Disposal					Offshore Repurposing/Disposal		
	Option 1a	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Personnel Transfers[1]	B2 – High	B2 – High	B2 – High	B1 – Moderate	B1 – Moderate	B1 – Moderate	B1 – Moderate	B1 – Moderate
	~880 transfers.	~880 transfers.	~880 transfers.	~400 transfers.	~160 transfers.	~120 transfers.	~120 transfers.	~200 transfers.
Lift of RTM Failure[2]	B1 – Moderate	B1 – Moderate	B1 – Moderate	B1 – Moderate	N/A	N/A	N/A	N/A
	Lifting operations present moderate safety risk.	Lifting operations present moderate safety risk.	Lifting operations presents moderate safety risk.	Lifting operations presents moderate safety risk.	Option does not require lifting operations.	Option does not require lifting operations.	Option does not require lifting operations.	Option does not require lifting operations.
Diving	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	All options can be undertaken without commercial divers.							
RTM Preparation/ Repair ***(Note: No confined space entry)***	C2 – Moderate	C2 – Moderate	C2 – Moderate	C2 – Moderate	C1 – Moderate	C2 – Moderate	C1 – Moderate	C2 – Moderate
	Work in a constricted working environment for j-tube repair and lifting work with extended duration.	Work in a constricted working environment for J-tube repair and lifting work with extended duration.	Work in a constricted working environment for J-tube repair and lifting work with extended duration.	RTM preparation, including installing lifting points and winches.	RTM preparation.	RTM preparation; including work in a constricted working environment to prepare for riser/ umbilical removal.	RTM preparation.	RTM preparation; including work in a constricted working environment to prepare and remove riser/ umbilical.
Vessel Collision During Tow	B1 – Moderate	B1 – Moderate	B1- Moderate	B1- Moderate	B1- Moderate	B1- Moderate	B1- Moderate	B1- Moderate
	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.	Risk of collision during tow resulting in multiple fatalities.
Riser Removal with RTM on seabed	N/A	N/A	N/A	N/A	N/A	C2 – Moderate	N/A	C2 – Moderate
						Recovery of risers to vessel deck, including lifting		Recovery of risers to vessel deck, including lifting

	Onshore Disposal					Offshore Repurposing/Disposal		
	Option 1a	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
						operations or line of fire hazards.		operations or line of fire hazards.

[1] Assumes enclosed personnel transfer. A unit of transfer is 4 people transferred one way in a WAVE-4 transfer basket and assumes maximum comfort breaks (transfer on and off every 3 hours).

[2] Assumes that all structural assessment and engineering studies demonstrate that the RTM can be safely lifted.

*Note: All risk rankings have been made using the Woodside Risk Matrix (**Table 2-3** and **Table 2-4**).*

The health and safety risk assessment determined that options 1a, 1b and 1c carry a high safety risk associated with personnel transfers to complete topsides work on the RTM, based on the number of personnel transfers required, while the remaining options carry a moderate risk. There are moderate risks associated with lift or RTM failure, RTM preparation and repair, vessel collision during tow, and riser removal whilst on the seabed.

For the selected option, health and safety risks will be managed to ALARP. For personnel transfers, rather than using a personnel transfer basket, a walk to work solution may be considered to reduce safety risk. Walk to work, which allows personnel transfer via a gangway, is a relatively new activity for the oil and gas industry and there are challenges associated with a walk to work solution for work on the RTM given the small topsides area of the RTM. Diving is not included in the base case for any of the options because of the risks involved. Diving would only be pursued if an alternative methodology using ROVs was not practicable.

Environment Impact and Risk Assessment

Under the Environment Regulations an environmental impact "means any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity of an operator." The definition of environment under the Environment Regulations is:

(a) ecosystems and their constituent parts, including people and communities; and

(b) natural and physical resources; and

(c) the qualities and characteristics of locations, places and areas; and

(d) the heritage value of places;

and includes

(a) the social, economic and cultural features of the matters mentioned in paragraphs (a), (b), (c) and (d).

Table 3-15 compares the environmental impacts and risks associated with each decommissioning option (**Section 3.6.2**), and identifies those where alternative options to those previously accepted by NOPSEMA (removal from the title area and onshore disposal, i.e. options 1a–1e) have the potential for equal or better outcomes. Alternative decommissioning options (e.g. options 2a–2c) were then further assessed based on the impacts and risks in **Section 3.6.3.3** to determine whether the option provides a better or equal outcome overall when compared to removal and onshore disposal. Common activities with impacts and risks that are equivalent (equal impact/risk ranking for all options) or comparable (same range of impact/risk ranking for onshore and offshore options) across both onshore and offshore disposal options were not considered relevant to the assessment of equal or better outcome.

Impacts and risks have been assessed in **Table 3-15** in accordance with the Woodside risk matrix. Beneficial impacts have been identified but are not ranked because beneficial impacts are not included in the Woodside risk matrix. Environmental impacts and risks associated with activities that are required for all options are not included in the assessment, including:

- standard ROV operations (unplanned hydraulic leaks, planned noise impacts and localised increases in turbidity)
- removal of miscellaneous items during RTM preparation work (dropped objects risk)
- cutting RTM mooring chains (planned swarf discharges and disturbance to seabed while chains are temporarily left on the seabed until final decommissioning of Enfield infrastructure)
- dropped objects onto live infrastructure during operations within the title area or during towing operations (routes will be selected to avoid these hazards)
- loss of solid hazardous waste

- socio-economic benefits of employment associated with RTM removal and disposal/ repurposing.

These impacts and risks are comprehensively assessed in **Section 6.7** for the selected option.

Table 3-15: Environment options assessment of RTM decommissioning options

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
Evaluation of Planned Activities (Environmental and Societal Impacts)										
Physical Presence	Interaction with or displacement of other users	×	F – negligible	F – negligible		F – negligible	F – negligible	F – negligible	F – negligible	F – negligible
		All options have equivalent impact.	Possible interference or displacement with other marine users, including commercial and recreational fishers, shipping traffic, tourist operators and defence from project vessels within the title area (duration 45–60 days) and during 1500 km tow to Henderson (tow duration 2–3 weeks). Potential impacts are expected to be slightly higher within nearshore environment upon arrival at Henderson, as well as given the RTM will be wet towed and the significant distance/duration of the tow. Note: As outlined in **Table 3-10**, wet towing must be conducted at a significantly slower speed than dry towing resulting in longer estimated durations.	Possible interference or displacement with other marine users, including commercial and recreational fishers, shipping traffic, tourist operators and defence from project vessels within the title area (duration 45–60 days) and during 550 km tow to Legendre Island (duration 7–10 days) and loadout onto vessel at Legendre Island (duration 3–5 days) then minimum 3000 km transport to a port in Southeast Asia (e.g. Batam or Singapore). (transport duration 5–10 days). Potential impacts are expected to be slightly higher during wet tow and within nearshore environment during lifting at Legendre Island and upon arrival at port in Southeast Asia.		Possible interference or displacement with other marine users, including commercial and recreational fishers, shipping traffic, tourist operators and defence from project vessels within the title area (duration 20–30 days) and during minimum 3000 km transport to a port in Southeast Asia (e.g. Batam or Singapore). (transport duration 5–10 days). Note: Dry tow impacts are expected to be less than during wet tow.	Possible interference or displacement with other marine users, including commercial and recreational fishers, shipping traffic, tourist operators and defence from project vessels within the title area (duration 10–15 days) and during ~3000 km wet tow to Batam (tow duration >5 weeks). Note: As outlined in **Table 3-10**, wet towing must be conducted at a significantly slower speed than dry towing resulting in longer estimated durations.	Possible interference or displacement with other marine users, including commercial fishers, shipping traffic and defence from project vessels within the title area (duration 20–30 days) and during 26 km tow to identified IAR location (tow duration 6–12 hours) and during IAR installation (installation duration 15–20 days). Impacts are expected to be slightly lower than options 1a–1e given the shorter distance/duration of the tow; however no lower consequence exists. No interference with or displacement of other users would be expected to occur as a result of the long-term presence of the IAR given the water depth where it would be located.	Possible interference or displacement with other marine users, including commercial fishers, shipping traffic, tourist operators and defence from project vessels within the title area (duration 15–20 days) and during 370 km tow to offshore water disposal location (tow duration 5–6 days). Impacts are expected to be slightly lower than options 1a–1e given the distance/duration of the tow and that it will not be towed through/into nearshore waters. No impacts to other users would be expected to occur as a result of sea dumping of due to deepwater location.	Possible interference or displacement with other marine users, including commercial fishers, shipping traffic, tourist operators and defence from project vessels within the title area (duration 20–30 days) and during tow to disposal location within title area (tow duration <6 hours). Impacts are expected to be slightly lower than other options 1a–1e given the distance/duration of the tow and that it will not be towed through/into nearshore waters.
		✓	N/A					Beneficial Impact	N/A	N/A

Impact/Risk Aspect		**Impact/Risk included in assessment of Equal or Better Outcome[1]**	**Onshore Disposal**					**Offshore Repurposing and Disposal**		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Social amenity associated with increased recreational fishing opportunities	Beneficial impact only associated with option 2a						Engagement with recreational fishing industry has identified opportunity to increase fish populations, and create a dedicated deepwater IAR. The proposed site has been selected based on engagement with recreational fishing industry and on suitability for demersal line fishing and pelagic fishing. The RTM, along with concrete reef modules, have been integrated in an IAR design to create ecological productivity as a result of surface area, shelter, interstitial spaces, upwelling, connectivity and the reef halo effect, along with a suitable location for fishing. Supported by Exmouth Game Fishing Club, WA Game Fishing Association, Shire of Exmouth, and the Exmouth Chamber of Commerce and Industry (ECCI), who represent a number of charter operators.		
		✓	N/A					Beneficial Impact	N/A	N/A

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Economic benefit to regional stakeholders associated with increased recreational fishing	Beneficial impact only associated with option 2a.						Recreational fishers in the Gascoyne region spend ~AU$27.5 M per year. Economic benefits to Exmouth and Gascoyne region associated with IAR include potential benefits to coastal resorts and tourism facilities, tourism and charter operators, tackle and boating industry, goods and services providers (hospitality/ fuel) and services for reef scientific monitoring.		
		✓	N/A					F – negligible	F – negligible	F – negligible

Impact/Risk Aspect		**Impact/Risk included in assessment of Equal or Better Outcome[1]**	**Onshore Disposal**					**Offshore Repurposing and Disposal**		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Disturbance to seabed and surrounding environment	Impact only associated with options 2a, 2b, 2c.	No disturbance to seabed identified, with the potential exception of anchoring of transport HLV (option 1c).					***Installation*** Short-term localised increase in turbidity within an ~1170 m^2 area in the identified IAR location (300 m × 300 m), associated with installation of RTM and augmentation structures. An additional 100 m temporary seabed disturbance, including turbidity will occur within the 300 m × 300 m area during removal of the risers as they are pulled from the RTM following placement on the seabed. ***IAR*** Seabed disturbance within an ~1170 m^2 area in the identified IAR location, as a result of the placement of the RTM and augmentation structures on the seabed. The proposed IAR location has been selected to avoid sensitive and protected habitat. Benthic surveys have found the area to be relatively featureless and comprising soft sediments with low-density epibiota and providing a suitable and safe site for an artificial reef (see **Section 4** for more details). The area is near the Ningaloo AMP and WHP.	Short-term localised increase in turbidity within an ~700 m^2 area within the identified offshore disposal location during installation. Seabed disturbance within an ~700 m^2 area within the identified offshore disposal location. This location would be selected to align with guidance for an artificial reef permit (i.e. >2000 m deep with no overlapping protected areas or other sensitivities).	Short-term localised increase in turbidity within an ~700 m^2 area within the identified offshore disposal location during installation. Seabed disturbance within an ~700 m^2 area within the identified offshore disposal location. An additional 100 m temporary seabed disturbance, including turbidity, will occur during removal of the risers as they are pulled from the RTM following placement on the seabed. The location would be selected based on water depth and avoiding impacts on other users, protected areas or other sensitivities.
		✓	N/A					Beneficial Impact	N/A	N/A

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Increase in hard substrate associated with RTM and concrete reef modules	Beneficial impact only associated with option 2a.						The RTM along with concrete reef modules have been integrated in an IAR design to create ecological productivity as a result of surface area, shelter, interstitial spaces, upwelling, connectivity and the reef halo effect, along with a suitable location for fishing. The IAR is expected to initially attract fish, however in the long-term has been designed to be productive, increasing fish populations. This may also result in reduced recreational fishing pressure on other natural habitats.		
Routine and non-routine discharges and emissions	Degradation of RTM	✓	N/A as recycling of most materials is assumed					F – no lasting effect	F – no lasting effect	F- no lasting effect
		Impact only associated with options 2a, 2b, 2c.	Steel and plastics associated with the RTM and risers can be recycled, and would be where practicable; however, the ability to recycle these products is limited by local (WA / Australian) capacity and complex global recycling markets. Transporting these materials long distances to international recycling facilities would erode some of the benefit achieved. Some items (e.g. foam) may not be able to be recycled and would need to be sent to landfill.					Over 100–400 years the predominantly steel RTM structure will corrode and break down, gradually releasing paint, corrosion products, hydraulic fluid (50 L), and concrete degradation products. The reef module structures will also break down and release corrosion products and concrete degradation products	Over 100–400 years the predominantly steel RTM structure will corrode and break down, gradually releasing paint, corrosion products, hydraulic fluid (50 L), and concrete degradation products.	Over 100–400 years the predominantly steel RTM structure will corrode and break down, gradually releasing paint, corrosion products, hydraulic fluid (50 L), and concrete degradation products.
		×	F- negligible	F- negligible		F- negligible	F- negligible	F- negligible	F- negligible	F- negligible

Impact/Risk Aspect		**Impact/Risk included in assessment of Equal or Better Outcome[1]**	**Onshore Disposal**					**Offshore Repurposing and Disposal**		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Routine discharges from project vessels (sewage, grey water, putrescible wastes, deck and bilge water) to marine environment	All options have equivalent impact.	Routine discharges from project vessels within the title area (45–60 days) and during 1500 km tow to Henderson (tow duration 2–3 weeks). Tow route would be designed to avoid protected areas where possible, however, may be required to traverse through multiple-use zones of the Gascoyne and Abrolhos AMPs given their spatial extents.	Routine discharges from project vessels within the title area (45–60 days) and during 550 km tow to Legendre Island (7–10 days) and loadout onto vessel at Legendre Island (duration 3–5 days) then ~3300 km transport to a port in Southeast Asia (tow duration 5–10 days). Tow route would be designed to avoid protected areas where possible.		Routine discharges from project vessels within the title area (20–30 days) and during ~3300 km transport to a port in Southeast Asia (transport duration 5–10 days). Tow route would be designed to avoid protected areas where possible.	Routine discharges from project vessels within the title area (10–15 days) and during ~3000 km wet tow to Indonesia (tow duration >5 weeks) Tow route would be designed to avoid protected areas where possible.	Routine discharges from project vessels within the title area (20–30 days) and during 26 km tow to proposed IAR location (tow duration 6–12 hours) and while installing IAR (15–20 days). The identified tow route does not overlap any protected area.	Routine discharges from project vessels within the title area (15–20 days) and during 370 km tow to offshore water disposal location (tow duration 5–6 days) and during sinking of RTM. The identified tow route does not overlap any protected area.	Routine discharges from project vessels within the title area (20–30 days) and during short tow (tow duration <6 hours) and during sinking of RTM. The title area does not overlap any protected area.
	Routine and non-routine discharges: hydrocarbons and chemicals to marine environment	×	F- negligible			N/A	N/A	F- negligible	F- negligible	F- negligible
		Both onshore and offshore options have comparable impact.	During repair and reballasting of the RTM, excess grout will be discharged during J-tube repair and non-treated seawater will be discharged from remaining ballast compartments.			No significant discharges are planned to occur. See unplanned discharges below.	No significant discharges are planned to occur. See unplanned discharges below.	The RTM topside's piping and umbilical will be flushed to remove residual chemicals before repurposing as an IAR. This will occur in the title area not at the IAR location. Residual chemicals may include small quantities of demulsifier, scale inhibitor, methanol and hydraulic fluid that would be released subsurface from the EHU tail. Following placement of the RTM at the identified IAR location excess grout (~0.5 m^3) may be discharged during encapsulation of foam in compartment 13. Up to ~0.5 L of residual hydrocarbons remaining in the flushed risers may slowly discharge as the risers are removed.	The RTM topside's piping and umbilical will be flushed to remove residual chemicals before disposing in deep water. This will occur in the title area. Residual chemicals may include small quantities of demulsifier, scale inhibitor, methanol and hydraulic fluid that would be released subsurface from the EHU tail. Following placement of the RTM at the identified offshore disposal location, up to ~0.5 L of residual hydrocarbons in the flushed risers will slowly disperse into the marine environment.	The RTM topside's piping and umbilical will be flushed to remove residual chemicals before disposing in the title area. This will occur in the title area. Residual chemicals may include small quantities of demulsifier, scale inhibitor, methanol and hydraulic fluid that would be released subsurface from the EHU tail. Following placement of the RTM at the disposal location excess grout (~0.5 m^3) may be discharged during encapsulation of foam in compartment 13. Following placement of the RTM at the identified location, up to ~0.5 L of residual hydrocarbons in the flushed risers will slowly disperse into the marine environment.

Impact/Risk Aspect		**Impact/Risk included in assessment of Equal or Better Outcome[1]**	**Onshore Disposal**					**Offshore Repurposing and Disposal**		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Routine light emissions from project vessels	×	E – slight	E – slight		F – negligible	F – negligible	E – slight	F – negligible	F – negligible
		Both onshore and offshore options have comparable impact	Light emissions from project vessels within the title area (duration 45–60 days) and during 1500 km tow to Henderson (tow duration 2–3 weeks). **Key seasonal sensitivities:** • BIAs for a number of bird species overlap the tow route, however, no habitat critical to the survival of a marine turtles overlaps the route (i.e. Ningaloo and North West Cape would be avoided during towing).	Light emissions from project vessels within the title area (duration 45–60 days) and during 550 km tow to Legendre Island (durations 7–10 days) and loadout onto vessel at Legendre Island (duration 3–5 days) then during ~3300 km transport to a port in Southeast Asia (tow duration 5–10 days). **Key seasonal sensitivities:** • Habitat critical for three marine turtle species and BIAs for three bird species (lesser crested tern, roseate tern, wedge-tailed shearwater) overlaps the wet tow route and Legendre Island where the RTM will be lifted from the water. • A number of additional seasonal sensitivities are expected to occur along the subsequent dry tow route to Southeast Asia.		Light emissions from project vessels within the title area (duration 20–30 days) and during ~3300 km transport to a port in South East Asia (transport duration 5–10 days). **Key seasonal sensitivities:** • No relevant BIAs or habitat critical to the survival of a species overlaps the tow route or proposed disposal location.	Light emissions from project vessels (10–15 days) within the title area and during ~3000 km tow to Indonesia (>5 weeks). **Key seasonal sensitivities:** • No relevant BIAs or habitat critical to the survival of a species overlaps the tow route or proposed disposal location.	Light emissions from project vessels within the title area (20–30 days) and during 26 km tow to proposed IAR location (tow duration 6–12 hours) and while installing IAR (installation duration (15–20 days). **Key seasonal sensitivities:** • Habitat critical for three marine turtle species and a BIA for the wedge-tailed shearwater overlaps the tow route and proposed IAR location.	Light emissions from project vessels within the title area (15–20 days) and during 370 km tow to offshore water disposal location (tow duration 5–6 days) and while sinking the RTM. **Key seasonal sensitivities:** • No relevant BIAs or habitat critical to the survival of a species overlaps the tow route or proposed disposal location.	Light emissions from project vessels within the title area (20–30 days) and during tow to disposal location within title area (tow duration <6 hours) and while sinking RTM. **Key seasonal sensitivities:** • No relevant BIAs or habitat critical to the survival of a species overlaps the tow route or proposed disposal location.
	Routine acoustic emissions from project vessels	×	F – negligible	F – negligible	F – negligible	F – negligible	F – negligible	F – negligible	F – negligible	F – negligible
		All options have equivalent impact.	Noise emissions from: • one PIV and two AHT vessels (all vessels will have DP) and ROV operations within the title area (45–60 days) • two AHT vessels (all vessels will have DP) during ~1500 km tow to Henderson (2–3 weeks). **Key seasonal sensitivities:** • RTM current location is within the migration BIA for pygmy blue whales.	Noise emissions from: • one PIV and two AHT vessels (all vessels will have DP) and ROV operations within the title area (45–60 days). • two AHT vessels during 550 km tow to Legendre Island (7–10 days) • two AHT and one semi-submersible vessels during float-over operations (all vessels will have DP) (3–5 days) • one semi-submersible vessel during ~3300 km transport to a port in Southeast Asia (5–10 days.	Noise emissions from: • one PIV and two AHT vessels (all vessels will have DP) and ROV operations with the title area (45–60 days). • two AHT vessels during 550 km tow to Legendre Island (7–10 days) • up to three AHT and one HLV vessels during lifting operations (AHTs on DP / HLV on anchor) (3–5 days) • one HLV vessels during ~3300 km transport to a port in Southeast Asia (5–10 days).	Noise emissions from • one HCV and up to two AHT vessels (all vessels will have DP) and ROV operations within the title area. Vessel thrusters will be run for 20–30 days during lifting • one HCV vessels during ~3300 km tow to a port in Southeast Asia (5–10 days). **Key seasonal sensitivities:** • RTM current location is within the migration BIA for pygmy blue whales.	Noise emissions from: • one PIV and two AHT vessels (all vessels will have DP) and ROV operations within the title area (10–15 days). • two AHT vessels during ~3300 km tow to Southeast Asia (>5 weeks). **Key seasonal sensitivities:** • RTM current location is within the migration BIA for pygmy blue whales.	Noise emissions from: • one PIV and two AHT vessels (all vessels will have DP) and ROV operations within the title area (20–30 days) • one PIV and two AHT vessels during 26 km tow to identified IAR location (6–12 hours) • one PIV and two AHT vessels (all vessels will have DP) and ROV operations at the identified IAR location (15–20 days). **Key seasonal sensitivities:**	Noise emissions from: • one PIV and up to two AHT vessels (all vessels will have DP) and ROV operations within the title area (15–20 days) • one PIV and up to two AHT vessels during 370 km tow to offshore water disposal location (5–6 days) • one PIV and up to two AHT vessels (all vessels will have DP) and ROV operations at offshore water disposal location (2–5 days). **Key seasonal sensitivities:**	Noise emissions from: • one PIV and up to two AHT vessels (all vessels will have DP) and ROV operations within the title area (20–30 days) • one PIV and up to two AHT vessels during short tow to disposal location in title area (<6 hours) • one PIV and two AHT vessels (all vessels will have DP) and ROV operations at disposal location in title area (duration included in days above). **Key seasonal sensitivities:**

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
				Key seasonal sensitivities: • RTM current location is within the migration BIA for pygmy blue whales • wet tow route to Legendre Island overlaps whale shark migration BIA • Habitat critical for three marine turtle species overlaps the wet tow route and Legendre Island where the RTM will be lifted from the water • A number of additional seasonal sensitivities are expected to occur along the subsequent dry tow route to Southeast Asia.		• A number of additional seasonal sensitives area expected to occur along the subsequent dry tow route to Southeast Asia.	• A number of additional seasonal sensitives area expected to occur along the subsequent wet tow route to Southeast Asia .	• RTM current location is within the migration BIA for pygmy blue whales • Habitat critical for three marine turtle species overlaps the tow route and proposed IAR location.	• RTM current location is within the migration BIA for pygmy blue whales.	• RTM current location is within the migration BIA for pygmy blue whales.
	Routine atmospheric emissions from project vessels	×	F – negligible	F – negligible		F – negligible	F – negligible	F – negligible	F – negligible	F – negligible
		All options have equivalent impact	Atmospheric emissions from project vessels within the title area and during 1500 km tow to Henderson (total duration ~60–80 days).	Atmospheric emissions from project vessels within the title area and during 550 km tow to Legendre Island, lifting operations, and ~3300 km tow to a port in Southeast Asia (total duration ~60–85 days) or for wet tow directly to Southeast Asia .		Atmospheric emissions from project vessels within the title area, lifting operations, and ~3300 km dry tow to a port in Southeast Asia (total duration ~25–40 days).	Atmospheric emissions from project vessels within the title area and ~3000 km tow to Southeast Asia (total duration ~45–50 days).	Atmospheric emissions from project vessels within the title area and during 26 km tow to proposed IAR location and installation of the IAR on the seabed (total duration ~35–50 days)	Atmospheric emissions from project vessels within the title area, during 370 km tow to offshore disposal location and during placement on the seabed (total duration ~22–30 days).	Atmospheric emissions from project vessels within the title area, during short (up to 5 km tow) to disposal and during placement on the seabed (total duration 20–30 days).
Evaluation of Unplanned Activities (Environmental and Societal Risks)										
Physical presence	Disturbance to seabed from dropped objects (Note: Towing routes will avoid protected areas, other sensitive areas and live infrastructure, where possible)	×	F2 – Low	F2 – Low	F2 – Low	F2 – Low	N/A	F2 – Low	N/A	N/A
		Both onshore and offshore options have comparable risk	Dropped objects that have the potential to occur include: • risers (85 m long) dropped during RTM repair within title area. • Bend stiffener section dropped after cut from RTM	Dropped objects that have the potential to occur include: • risers (85 m long) dropped during RTM repair within title area. • Bend stiffener section dropped after cut from RTM	Dropped objects that have the potential to occur include: • risers (85 m long) dropped during RTM repair within title area. • Bend stiffener section dropped after cut from RTM	Dropped objects that have the potential to occur include: • lifting trunnion, donut, or winches dropped during installation.	Potential for dropped objects associated with routine vessel activities only.	Dropped objects that have the potential to occur include: • risers (85 m long) dropped while they are being pulled from the RTM at identified IAR location. • Bend stiffener section dropped after cut from RTM	Potential for dropped objects associated with routine vessel activities only. • Bend stiffener section dropped after cut from RTM	Dropped objects that have the potential to occur include: • risers (85 m long) dropped while they are being pulled from the RTM at identified IAR location. • Bend stiffener section dropped after cut from RTM
		✓	D2 – Moderate	D1- Moderate		N/A	D2 – Moderate	D0- Low	D1- Moderate	D0- Low

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Loss of control of the RTM during removal and wet tow resulting in impacts to offshore and nearshore habitats, communities and marine users	Onshore and offshore options have different risks. (e.g. onshore risk range D1-D2; offshore risk range D0-D1)	During 1500 km tow to Henderson (tow duration 2–3 weeks), there is a potential for vessels to lose control of the RTM. Given the duration and distance for the tow this may occur due to unforeseen adverse weather or RTM repair failure. If control of the RTM was lost, the RTM could potentially sink in offshore waters, or float to / near shore.	During 550 km tow to Legendre Island (tow duration 7–10 days), there is a potential for vessels to lose control of the RTM. Given the duration and distance for the tow this may occur due to unforeseen adverse weather (including potential for cyclones) or RTM repair failure. If control of the RTM was lost, the RTM could potentially sink in offshore waters (potentially over existing subsea infrastructure), or float to / near shore. The likelihood of this occurring is lower than for a tow to Henderson given the shorter duration and ability to forecast weather more accurately over a shorter period.		No wet tow.	During 3300 km tow to Southeast Asia (tow duration >5 weeks), there is a potential for vessels to lose control of the RTM. Given the duration and distance for the tow this may occur due to unforeseen adverse weather or RTM structural fatigue failure. If control of the RTM was lost, the RTM could potentially sink in offshore waters, or float to / near shore. The likelihood of this occurring is increased relative to other options given the longer duration of the tow.	During 26 km tow to IAR location (6–12 hours), there is a potential for vessels to lose control of the RTM. The likelihood of this occurring is lower than for a longer tow as weather forecasts will be more accurate over a shorter period and an appropriate weather window can be selected, before disconnecting the mooring chains of the RTM.	During 370km tow to deep-water disposal location (5–6 days), there is a potential for vessels to lose control of the RTM. Given the duration and distance for the tow this may occur due to unforeseen adverse weather (including potential for cyclones). The likelihood of this occurring is lower than for a tow to Henderson given the shorter duration and ability to forecast weather more accurately over a shorter period.	During short tow to disposal location (<6 hours), there is a potential for vessels to lose control of the RTM. The likelihood of this occurring is lower than for a longer tow as weather forecasts will be more accurate over a shorter period and an appropriate weather window can be selected, before disconnecting the mooring chains of the RTM.
		×	B0 – Moderate	B0 – Moderate		D0 – Low	D0 – Low	B0 – Moderate	D0 – Low	D0 – Low
	Accidental introduction of invasive marine species from project vessels (Note: All vessels will be subject to Woodside's invasive marine species [IMS] risk assessment process described in **Section 6.7.2.7**)	Both onshore and offshore options have comparable risk.	Risk of IMS from project vessels during operations within the title area and during towing to Henderson.	Risk of IMS from project vessels during operations within the title area, towing to Legendre Island, lifting operations and during dry tow to Southeast Asia.		Risk of IMS from project vessels during operations within the title area, and during dry tow to Southeast Asia.	Risk of IMS from project vessels during operations within the title area, and during wet tow to Batam.	Risk of IMS from project vessels during operations within the title area, towing to identified IAR location and installing IAR on the seabed.	Risk of IMS from project vessels during operations within the title area, towing to identified offshore disposal location and sinking the RTM to the seabed.	Risk of IMS from project vessels during operations within the title area, towing to location within title area and sinking the RTM to the seabed.
		×	E1 – Low	E1 – Low		E1 – Low	E1 – Low	E1 – Low	E1 – Low	E1 – Low

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Vessel collision with marine fauna	All options have equivalent risks (low).	Collision with marine fauna and project vessels may occur during RTM preparation, repair and during the ~1500 km tow to Henderson. The tow will be conducted at low speeds (average 2 knots), and as a result it is considered highly unlikely that a collision would occur. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales.	Collision with marine fauna and project vessels may occur during RTM preparation, repair/deballasting, during the ~550 km wet tow to Legendre Island, lifting operations at Legendre Island, and ~3300 km transport to a port in Southeast Asia. The tow will be conducted at low speeds (average 2 knots), and as a result it is considered highly unlikely that a collision would occur. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales • Wet tow route to Legendre Island overlaps whale shark migration BIA • Habitat critical for three marine turtle species overlaps the wet tow route and Legendre Island where the RTM will be lifted from the water • A number of additional seasonal sensitivities are expected to occur along the subsequent dry tow route to Southeast Asia.		Collision with marine fauna and project vessels may occur during RTM preparation, lifting and during the ~3300 km transport to a port in Southeast Asia. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales • A number of additional seasonal sensitivities are expected to occur along the subsequent dry tow route to Southeast Asia.	Collision with marine fauna and project vessels may occur during RTM preparation, and during the ~3300 km wet tow to Indonesia. The tow will be conducted at low speeds (average 2 knots), and as a result it is considered highly unlikely that a collision would occur. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales • A number of additional seasonal sensitivities are expected to occur along the subsequent wet tow route to Southeast Asia.	Collision with marine fauna and project vessels may occur during RTM preparation, during the ~26 km tow to the identified IAR location and during installation of the IAR. The tow will be conducted at low speeds (average 1.5 knots), and as a result it is considered highly unlikely that a collision would occur. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales • Habitat critical for three marine turtle species overlaps the tow route and proposed IAR location.	Collision with marine fauna and project vessels may occur during RTM preparation, during the 370 km tow to offshore deepwater disposal location and during scuttling activities. The tow will be conducted at low speeds (average 1.5 knots), and as a result it is considered highly unlikely that a collision would occur. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales.	Collision with marine fauna and project vessels may occur during RTM preparation, during the up to 5 km tow to offshore water disposal location and during scuttling activities. The tow will be conducted at low speeds (average 1.5 knots), and as a result it is considered highly unlikely that a collision would occur. **Key seasonal sensitivities**: • RTM current location is within the migration BIA for pygmy blue whales.
Accidental Hydrocarbon Release	Vessel collision resulting in diesel spill	×	C1- Moderate	C1- Moderate		D1- Moderate	D1 – Moderate	D1 – Moderate	D1 – Moderate	D1 – Moderate
		All options have equivalent risks (moderate).	Credible worst-case spill: 500 m^3 marine diesel spill from AHT vessel in nearshore waters off Perth. Consequence of a spill is higher given potential larger volume to be spilled, and that the spill may take place in shallow nearshore waters off Perth. Likelihood is slightly higher given duration and distance required for the tow.	Credible worst-case spill: 1000 m^3 marine diesel spill from semi-submersible or transport HLV at Legendre Island/nearshore waters in Southeast Asia. Consequence of a spill is higher given larger volume to be spilled, and that the spill may take place in shallow nearshore waters.		Credible worst-case spill: 1000 m^3 marine diesel spill from HCV at current location of RTM.	Credible worst-case spill: 500 m^3 marine diesel spill from PIV at current location of RTM (38 km north of North West Cape).	Credible worst-case spill: 500 m^3 marine diesel spill from PIV at identified IAR location (16 km north of North West Cape).	Credible worst-case spill: 500 m^3 marine diesel spill from PIV at current location of RTM (38 km north of North West Cape).	Credible worst-case spill: 500 m^3 marine diesel spill from PIV at current location of RTM (38 km north of North West Cape).
		×	E2 – Moderate	E2 – Moderate		E2 – Moderate	E2 – Moderate	E2 – Moderate	E2 – Moderate	E2 – Moderate

Impact/Risk Aspect		**Impact/Risk included in assessment of Equal or Better Outcome[1]**	**Onshore Disposal**					**Offshore Repurposing and Disposal**		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
Unplanned discharges	Loss of chemicals/ hydrocarbons from RTM or project vessels	All options have equivalent risks (moderate)	Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • Approximately 5 L of hydraulic fluids may be released from valve activation during deballasting operations within the title area. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot. • Chemicals in umbilical (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be released during umbilical removal of the RTM.	Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • Approximately 5 L of hydraulic fluids may be released from valve activation during deballasting operations within the title area • unplanned discharges of hydraulic fluids or diesel during lifting operations near Legendre Island. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot. • Chemicals in umbilical (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be released during umbilical removal.		Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot. • Chemicals in umbilical (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be released during umbilical removal.	Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot. • Chemicals in umbilical (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be released during umbilical removal.	Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot.	Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot.	Unplanned discharge risks include: • Deck spills from stored hydrocarbons/ chemicals or equipment. • 160 L of chemicals (demulsifier, scale inhibitor, methanol and hydraulic fluid) may be accidentally released during decanting of the drain pot.
		✓	N/A					E1 – Low	E1 – Low	E1 -Low

Impact/Risk Aspect		Impact/Risk included in assessment of Equal or Better Outcome[1]	Onshore Disposal					Offshore Repurposing and Disposal		
Option number			***Option 1a***	***Option 1b***	***Option 1c***	***Option 1d***	***Option 1e***	***Option 2a***	***Option 2b***	***Option 2c***
Option description			***Repair and Wet Tow***	***Repair and Semi-submersible***	***Repair and HLV***	***Infield HCV***	***Tow to Deep Port***	***Repurpose as IAR***	***Deep Water Disposal***	***Disposal in Title Area***
Key option activities			• RTM repair • deballast RTM • wet tow to shore (Henderson)	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • load onto semi-sub • dry tow to Southeast Asia	• RTM repair • deballast RTM • tow to sheltered water (Legendre Island) • HLV lift • dry tow to Southeast Asia	• no repair • install rigging/cradle • infield HCV lift • dry tow to Southeast Asia	• no repair • wet tow to Indonesia (Batam)	• no repair • tow to IAR location • place on seabed • remove risers and grout foam • install reef modules	• no repair • tow to deepwater • sink to seabed	• no repair • tow to suitable location in title area • sink to seabed • remove risers and grout foam
	Unplanned release of plastics	Risk only associated with offshore repurposing and disposal, unless RTM is lost during tow.						Foam and bend stiffeners will be grouted. Given seabed conditions (low light, low temperature, low currents) and presence of multiple barriers to the environment (steel, grout, marine growth), there is no credible degradation mechanism for plastics. If degradation occurs, it would not result in a potential impact greater than slight and temporary disruption to a small proportion of biological populations. Flexible risers and umbilical are planned to be removed; however, if one of the j-tubes is impinged then an additional 3.3 tonnes of plastic would remain (largest riser).	Foam, bend stiffeners and risers unable to be grouted. Given deepwater conditions (low light, low temperature, low currents), there is no credible degradation mechanism for plastics. If degradation occurs, it would not result in a potential impact greater than slight and temporary disruption to a small proportion of biological populations.	Foam and bend stiffeners will be grouted. Given seabed conditions (low light, low temperature, low currents) and presence of multiple barriers to the environment (steel, grout, marine growth), there is no credible degradation mechanism for plastics. If degradation occurs, it would not result in a potential impact greater than slight and temporary disruption to a small proportion of biological populations. Flexible risers and umbilical are planned to be removed; however, if one of the j-tubes is impinged then an additional 3.3 tonnes of plastic would remain (largest riser).

[1] For this column a tick identifies aspects where alternate options (options 2a-2c) have different environmental outcomes when compared to the previously accepted option of removal from the title area and onshore disposal (options 1a-1e). A cross indicates aspect is equivalent or comparable for all options.

*Note: All impact/risk rankings have been made using the Woodside Risk Matrix (**Table 2-3** and **Table 2-4**).*

As detailed in **Table 3-15**, the environmental impacts and risks are considered a comparable order of magnitude for all options when assessed using the Woodside Risk Matrix:

- All options have equivalent impacts and risks associated with removing the RTM from its current moored location.
- Risks associated with a wet tow are greater for options 1a, 1b, 1c, 1e, and 2b.
- There are additional adverse and beneficial impacts and risks associated with options 2a, 2b and 2c. Impacts are negligible and risks are moderate (comparable order of magnitude for risks and impacts as for onshore disposal).

Practicability Conclusion

The results from evaluating the technical feasibility, schedule, health and safety risk and environmental risks and impacts for each option is summarised in **Table 3-16**. From this, an assessment of overall option practicability has been made.

Table 3-16: Summary of results of practicability criteria evaluation

Option	Technical Feasibility		Schedule (by end April 21)	Health and Safety Risk (highest)	Environment		Practicability	
	Technical Complexity	*Probability of Success*			*Impacts (range)*	*Risks (highest)*	*Assessment*	*Practicability*
Option 1a – Repair and Wet Tow	High	Low	×	High	E-F	Moderate	High technical complexity and low probability of success, high safety risk and does not meet target schedule relative to comparable magnitude of environment impacts and risks for all options results in Option 1a being considered not reasonably practicable.	Not reasonably practicable
Option 1b – Repair and Semi-submersible	High	Low	×	High	E-F	Moderate	High technical complexity and low probability of success, high safety risk and does not meet target schedule relative to comparable magnitude of environment impacts and risks for all options results in Option 1b being considered not reasonably practicable.	Not reasonably practicable
Option 1c – Repair and HLV	High	Low	×	High	E-F	Moderate	High technical complexity and low probability of success, high safety risk and does not meet target schedule relative to comparable magnitude of environment impacts and risks for all options results in Option 1c being considered not reasonably practicable.	Not reasonably Practicable
Option 1d – Infield HCV	High	Low	×	Moderate	E-F	Moderate	High technical complexity and low probability of success, moderate safety risk and does not meet target schedule relative to comparable magnitude of environment impacts and risks for all options results in Option 1d being considered not reasonably practicable.	Not reasonably practicable

Option 1e – Tow to Deep Port	Moderate	Low	✗	Moderate	E-F	Moderate	Moderate technical complexity and low probability of success, moderate safety risk and does not meet target schedule relative to comparable magnitude of environment impacts and risks for all options results in Option 1e being considered not reasonably practicable.	Not reasonably practicable
Option 2a – IAR	Low	High	✓	Moderate	E-F	Moderate	Low technical complexity and high probability of success, moderate safety risks and meets target schedule relative to comparable magnitude of environment impacts and risks for all options and results in Option 2a being reasonably practicable.	Reasonably practicable
Option 2b – Deepwater Disposal	Moderate	Moderate/ High	✓	Moderate	E-F	Moderate	Moderate technical complexity and moderate to high probability of success, moderate safety risks and meets target schedule relative to comparable magnitude of environment impacts and risks for all options and results in Option 2b being reasonably practicable.	Reasonably practicable
Option 2c – Disposal in Title Area	Low	Moderate	✓	Moderate	E-F	Moderate	Low technical complexity and moderate probability of success, moderate safety risks and meets target schedule relative to comparable magnitude of environment impacts and risks for all options and results in Option 2c being reasonably practicable.	Reasonably practicable

Based on the assessment in **Table 3-16**, options 2a, 2b and 2c are more technically feasible, meet the target schedule and have comparable or lower health and safety risks and comparable environmental impacts and risks, than options 1a-1e. Therefore, options 1a-1e are not considered practicable and have not been further assessed. Options 2a, 2b and 2c are considered practicable and have been assessed for an equal or better environmental outcome to onshore disposal, in order to select a preferred option.

3.6.3.3 Equal or Better Outcome

The Offshore Petroleum Decommissioning Guideline (DIIS, 2018) states that "*options other than complete removal may be considered, however the titleholder must demonstrate that the alternative decommissioning approach delivers equal or better environmental, safety and well integrity outcomes compared to complete removal*." All options (except 2c) involve complete removal of the RTM from the title area, and would therefore potentially meet this requirement. However, given onshore disposal was the basis upon which the EP was accepted, this analysis considers "complete removal" to involve onshore disposal. Note: Because onshore disposal has been deemed not reasonably practicable (**Section 3.6.3.2**), this assumption may need to be revisited if option 2a is not accepted.

The assessment of equal or better outcome for practicable alternative options 2a, 2b, and 2c is based on the environmental impact and risk assessment conducted, as described in **Section 3.6.3.2**. Safety was excluded from this analysis because health and safety risks for all options are considered tolerable. The environmental impacts and risks identified as relevant to the assessment of equal or better outcome are those where the impacts and risks differed between options in **Table 3-15**; these are summarised in **Table 3-17**.

The impacts and risks identified in **Table 3-17** are all associated with the long-term presence of the RTM in the marine environment, which is considered the key difference between onshore disposal and offshore repurposing and disposal. The impacts and risks associated with removing the RTM from the title area, towing the RTM for either onshore disposal or offshore disposal/repurposing and other offshore vessel activities are considered broadly comparable. The exception to this is loss of control of the RTM during tow, which has a higher risk for onshore disposal options; however, for simplicity these impacts and risks have been excluded from the assessment.

Table 3-17: Assessment of equal or better environmental outcomes of the assessed decommissioning options

Impact/ Risk/ Benefit	Relevant Options	Comprehensive evaluation of impact/risk for selected option
Physical Presence – Social amenity associated with increased recreational fishing opportunities	2a	**Section 6.7.1.1**
Physical Presence – Economic benefit to regional stakeholders associated with increased recreational fishing activity	2a	**Section 6.7.1.1**
Physical Presence – Disturbance to seabed and surrounding environment	2a, 2b, 2c	**Section 6.7.1.2**
Physical Presence – Increase in hard substrate from long-term physical presence of RTM and concrete reef modules	2a	**Section 6.7.1.2**
Routine and Non-routine emissions and discharges – Degradation of RTM	2a, 2b, 2c	**Section 6.7.1.3**
Physical Presence – Loss of control of RTM	2a, 2b, 2c	**Section 6.7.2.6**
Unplanned discharges – Unplanned release of plastics	2a, 2b, 2c	**Section 6.7.2.1**

The first step in evaluating equal or better outcome was to weigh the impacts and risks with any potential benefits for each of the alternative options (options 2a, 2b, and 2c). The balance of the beneficial impacts occurring over a minimum 100 year period (based on RTM degradation; see **Section 6.7.1.3**), were evaluated relative to the adverse impacts and risks considered in perpetuity.

Then, a comparison was made between the residual impacts, risks and benefits of each alternative option and onshore disposal over the life of the IAR to determine whether there is an equal or better outcome. The assessments are summarised in **Table 3-18**, **Table 3-19**, and **Table 3-20**.

Table 3-18: Option 2a: Assessment of equal or better environmental outcome

Beneficial Impacts		Adverse Impacts and Risks	
Description	***Duration (years)***	***Description***	***Duration (years)***
Physical Presence – Social amenity associated with increased recreational fishing opportunities	>100	Physical Presence – Disturbance to seabed and surrounding environment (F-Negligible)	100–400
Physical Presence – Economic benefit to regional stakeholders associated with increased recreational fishing activity.	>100	Routine and Non-Routine emissions and Discharges – Degradation of RTM (F-Negligible)	100–400
Physical Presence – Increase in hard substrate from long-term physical presence of RTM and concrete reef modules.	>100	Unplanned discharges – Unplanned release of plastics (Low Risk)	Risk
Assessment: The impacts and risks associated with removing the RTM from the title area and towing are considered comparable for both onshore and offshore options and have not been included in the assessment above. The adverse impacts associated with an IAR have been assessed as negligible and the risk associated with unplanned discharges of plastics is considered low. The beneficial impacts associated with the IAR over a period of at least 100 years include social amenity associated with recreational fishing opportunities, economic benefit to regional stakeholders and by increasing fish productivity and reducing fishing pressure in other areas. These beneficial impacts are considered to offset or more than offset adverse impacts and risks, resulting in an equal or better environmental outcome for offshore repurposing as compared to onshore disposal.			

Table 3-19: Option 2b: Assessment of equal or better environmental outcome

Beneficial Impacts		Adverse Impacts and Risks	
Description	***Duration (years)***	***Description***	***Duration (years)***
N/A	N/A	Physical Presence – Disturbance to seabed and surrounding environment (F-Negligible)	100–400
		Routine and Non-Routine emissions and Discharges – Degradation of RTM (F-negligible)	100–400
		Unplanned discharges – Unplanned release of plastics (Low Risk)	Risk
Assessment: The impacts and risks associated with removing the RTM from the title area and towing are considered comparable for both onshore and offshore options and have not been included in the assessment above. The adverse impacts associated with deepwater disposal have been assessed as negligible and the risk associated with unplanned discharges of plastics is considered low. Although the adverse impacts and risks are considered negligible and low, because there are no beneficial impacts that offset the key adverse impacts and risks, this option is not considered to result in an equal or better environmental outcome based on the analysis completed to date.			

Table 3-20: Option 2c: Assessment of equal or better environmental outcome

Beneficial Impacts		Adverse Impacts and Risks	
Description	***Duration (years)***	***Description***	***Duration (years)***

N/A	N/A	Physical Presence – Disturbance to seabed and surrounding environment (F-Negligible)	100–400
		Routine and Non-Routine emissions and Discharges – Degradation of RTM (F-negligible)	100–400
		Unplanned discharges – Unplanned release of plastics (Low Risk)	Risk
Assessment: The impacts and risks associated with removing the RTM from the title area and towing are considered comparable for both onshore and offshore options and have not been included in the assessment above. The adverse impacts associated with disposal in the title area have been assessed as negligible and the risk associated with unplanned discharges of plastics is considered low. Because there are no beneficial impacts that offset the adverse impacts and risks, this option is not considered to result in an equal or better environmental outcome based on the analysis completed to date.			

Option 2a is able to demonstrate an equal or better environmental outcome, because the beneficial impacts associated with an IAR are greater than or equal to the adverse impacts, and because any residual impacts or risks are equal or less than those identified for onshore disposal options. The reef location and design are expected to result in social benefits associated with increased recreational fishing and economic benefits to regional stakeholders (including fishing, tourism and hospitality operators) and is supported by regional fishing industry stakeholders (**Section 6.7.1.1**). Providing a targeted fishing location results in less fishing pressure on other locations, with an associated environmental benefit (**Section 6.7.1.2**).

3.6.4 Recommendation

Option 2a is recommended as it meets legislative requirements, is reasonably practicable and results in an equal or better outcome than the decommissioning option in the NOPSEMA-accepted EP.

3.7 RTM Activities

3.7.1 RTM IMMR Activities

IMMR activities relevant to the RTM are listed in **Table 3-21**. The frequency and type of IMMR activities undertaken on the RTM will be in accordance with Lloyds Rules and Regulations for the Classification of a Floating Offshore Installation at a Fixed Location (Class rules).

Given the internal failure of the j-tube (**Section 1.1**), a third party engineering assessment of RTM failure mechanisms, considering inspection reports and as-built documentation, was completed in January 2020. The third party assessment, along with an internal engineering analysis, has provided confidence that the RTM will remain in a state that will allow removal from Operational Area 1. This supports the decision that the RTM's integrity is sufficient to withstand another year on location (target removal by April 2021). Based on the third party engineering assessment and internal engineering analysis, additional controls to further monitor the draft of the RTM ,and to reduce the risk of vessel collision with the RTM if it did submerge, were implemented in March 2020, including:

- installation of a remote RTM draft monitoring system. The remote monitoring of the RTM draft enables the positional data and relative height above the sea surface to be monitored online. The system has been automated to provide notification of any discrepancies in the RTM relative position or change in draft. This system will be inspected and maintained on a yearly basis
- additional external visual inspections (consistent with **Table 3-21**)
- installation of additional navigation aid system
- installation of an active radar system (in addition to the passive system already installed)

- installation of a self-deploying submerged navigation sentry buoy to mark and warn vessels trespassing into the 500 m petroleum safety zone that the hazard is submerged.

Table 3-21: RTM IMMR activities and frequencies

Activity	Location	Description	Last Inspection	Approximate Frequency
Offshore In-water Survey	RTM structure below waterline	Routine visual inspection of riser column and upper section of mooring legs using a support vessel and ROV (as required).	Dec 2018	2.5-yearly
Offshore In-water Survey	Mooring lines and anchors	Routine visual inspection of riser column and mooring legs using a support vessel and ROV (as required)	2016	5-yearly
Visual Inspection	RTM topsides	Routine visual inspection of topsides structure and accessories (e.g. navigation lights and passive reflective radar)[2]	March 2020[1]	Annual
Testing	Navigation aids	Routine testing of the navigation aids	March 2020	Annual
Submergence and Navigation Aids Check	RTM above waterline and navigation aids	Routine confirmation of submergence of RTM and navigation aids are operational	Ongoing	Weekly
RTM draft monitoring	RTM above water monitoring	Remote monitoring of RTM Draft	Installed March 2020	Annual
Visual Inspection	RTM and navigation aids	For-cause inspection, e.g. following a cyclone; navigation light failure.	Installed March 2020	As required

[1] Included replacing the existing navigation lighting system and visually inspecting the topsides structure inspection. No significant anomalies were identified.

[2] conducted from the Ngujima Yin FPSO located about 8 km north-east of the RTM.

3.7.1.1 Internal Inspection

There is limited additional information benefit associated with undertaking a compartment inspection. No compartments other than compartment 2 are affected by the design flaw that resulted in the internal failure of the j-tube. Compartment 1 contains iron ore and water and compartment 2 and 3 are ballasted with water that is not practicable to remove, so these compartments would be unable to be inspected. The next compartment that would be considered for inspection is compartment 4, which could be inspected at boundaries and penetrations; however, desktop reviews have not identified any specific integrity concerns for compartment 4, so there would be limited additional benefit associated with inspecting compartment 4.

A physical compartment inspection would require a confined space entry. Under the RTM safety case, only 4 people are allowed access to the RTM to undertake work, as this is the maximum number that can be evacuated from the RTM. In accordance with Woodside procedures, 7 people would be required to do a confined space entry to inspect one of the lower compartments (e.g. compartment 4): a sentry at the top of the access shaft (1 person), breathing apparatus monitor (1 person), rescue team (2 people), sentry at manway (1 person), compartment inspection (2 people). Given the personnel limitations on the RTM, a confined space entry to inspect the compartment would not be able to be undertaken.

3.7.2 RTM Removal

Activities to prepare the RTM for removal include:

- physically removing ancillary items such as cabling, hoses, life-rings, navigation lights, and wiring, which will require personnel access to the RTM
- removing or flushing chemicals that remain in chemical piping, the EHU and a drain pot located on the outer access platform
- preparation works for riser removal at IAR site
- removing and recovering the riser bend stiffeners and riser tail stub sections that protrude below the base of the RTM (**Figure 3-4**); this will be undertaken with ROVs using cutting tools.

Once all preparation activities are complete, a PIV together with AHTs be used to attach a tow line to the RTM, and disconnect the RTM from its nine anchor chains, which will be laid on the seabed. The RTM will then be towed from the title area using a tow line connected to either the PIV or an AHT. All tow operations shall be verified and monitored by a Marine Warranty Surveyor. The in-title area activities are planned to take 20–30 days, as described in **Table 3-3**.

3.7.3 As Left Status

The disconnected anchor lines and anchors will be left in place and laid down on the seabed for future field decommissioning.

3.7.4 IAR Activities

IAR activities involve towing and placing the RTM on the seabed at the IAR site, stabilising and modifying the RTM, and placing reef modules to augment the RTM to create an IAR. These activities will all occur within Operational Area 2. Towing will follow on from the preparation activities of the RTM while on location and disconnection of the RTM from its mooring chains (**Section 3.7.2**). The RTM will be towed about 26 km in a vertical position from its current location to the IAR site using an AHT. This vessel will be accompanied by an assisting AHT and PIV to the IAR site. The tow route will avoid marine parks, existing subsea and surface infrastructure, and where possible other petroleum permits (**Figure 3-2)**.

Site work at the reef location will then include sinking the RTM to the seafloor in a vertical orientation by controlled flooding of three to four ballast compartments. This will be undertaken using an ROV from the PIV while one or two AHTs hold the RTM on station. Once the RTM lands on the seabed it will rotate into a horizontal position; the AHTs will support this operation as necessary to achieve the desired heading. The RTM will then be further stabilised by flooding additional compartments.

Modifying the RTM includes encapsulating the foam in compartment 13 and removing the risers and EHU from the j-tubes. The foam in compartment 13 will compress under hydrostatic pressure up to about 10% of its current volume. The compressed foam will be encapsulated with grout by filling the empty void space. This will prevent the foam from being exposed to the marine environment.

The flexible risers and EHU will then be removed by connecting a haul line to the top of the riser/EHU using an ROV and pulling them out horizontally onto the seabed before lifting them to the surface. The flexible risers and EHU will be taken to shore for disposal. An ROV will be used to try to remove any remaining bend stiffener material; any unrecoverable bend stiffener material will be encapsulated with grout.

The RTM will also be augmented to create an IAR by installing purpose-built reef modules around it. Approximately 24 large purpose-built concrete reef modules (4 m x 4 m x 5 m in size) and 24 small modules (2.1 m round x 1.8 m high in size) will be installed on the seafloor using the PIV and AHTs. The reef design is depicted in **Figure 3-13**.

A video survey of the IAR will then be performed. Ongoing reef monitoring and management will be undertaken by Recfishwest for 30 years after installing the artificial reef, in accordance with the artificial reef permit. This is described further in **Section 7.5.4**.

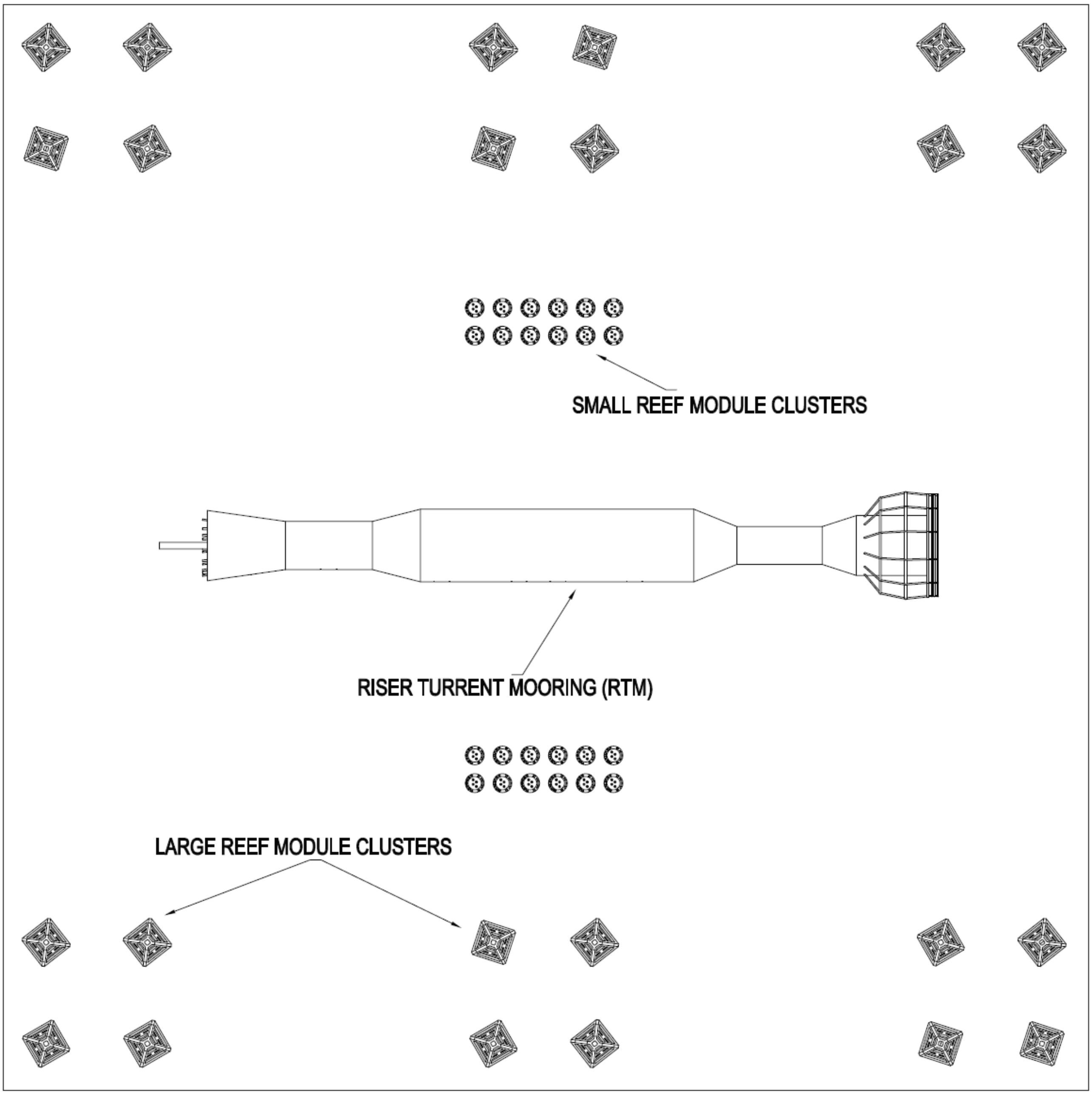


Figure 3-13: Proposed layout of the integrated artificial reef (maximum area: 300 m × 300 m)

3.8 Subsea IMMR Activities

3.8.1 Overview

Subsea infrastructure has been designed and left in a state of preservation that will not require any significant degree of intervention. However, IMMR is undertaken to ensure the integrity of the infrastructure for future decommissioning (complete removal as the base case under the OPGGS Act) and to identify and respond to any problems before they present a risk of loss of containment or prevent complete removal in the future. IMMR activities are typically undertaken from a diving support vessel or installation support vessel via ROV and/or divers.

IMMR activities often require deployment frames/baskets, which are temporarily placed on the seabed. These frames/baskets typically have a perforated base with a seabed footprint of about 15 m^2. The frames/baskets are recovered to the vessel at the end of the activity.

3.8.2 Inspection Frequencies

Subsea infrastructure inspections physically verify and assess components to detect changes to the as-installed location and condition by comparing them to previous inspections. The frequency and scope of subsea and flowline inspection activities are determined using a risk-based inspection (RBI) methodology, resulting in detailed RBI plans. RBI planning is undertaken by subject matter experts to determine what future activities are required and at what frequency. The frequencies listed in **Table 3-22** are designed to suit the isolated and shut-in condition of the wells and flushed condition of the flowlines, risers, and structures. As the flowlines and risers have been preserved with 1000 ppm of preservation fluid (Hydrosure O-367R), no subsea inspection of infrastructure other than the wells is required for the period of this EP. Hydrosure has been added to inhibit corrosion and prevent biofouling, so as to preserve the infrastructure until it is decommissioned. Based on initial testing over an 8-month period, there may be little reduction in Hydrosure concentration over a nominated 5-year period, resulting in a sufficient preservation period beyond this. The requirement to inspect subsea infrastructure and the frequency of inspection will be revisited at the end of five years after production ceases.

With the FPSO off-station, online monitoring of the subsea system is redundant and therefore condition monitoring is reduced to visual inspections. Before ceasing production, an extensive investigation and risk analysis was conducted of the Enfield well integrity. This 2017 review investigated risks from the point of ceasing production through to permanent plugging for abandonment activities. This review remains valid, with identified risks, analysis and control measures still applicable. In 2018 a further review into the corrosion risks as the wells approached cessation of production and suspension of well activities prior to abandonment was completed. The review concluded that during the suspended well status the advance of corrosion and loss of wall thickness to the carbon steel casing of the wells would be limited due to the wells no longer flowing, and that the integrity of these barriers would retain design integrity requirements.

Since this assessment was made, production has ceased and all subsea Xmas tree barriers have been closed and tested, including all production bore barriers, annulus bore barriers. All control line vents have been closed. The status of the Enfield wells is such that the risk of a loss of containment now is less than that in the operations phase. The wells are in a “static state”, thus reducing corrosion advancement.

During the operations phase the subsea Xmas trees on Enfield were visually inspected by ROV every four years, on average. Although the risk of corrosion or degradation leading to loss of containment is now lower than during the operations phase, Woodside will undertake a visual inspection at least once before the end of 2022, when permanent abandonment activities are planned to commence (**Section 3.4**). If these wells remain active, the frequency will be reassessed as required under the WOMP.

Subsea well inspection will be managed under the NOPSEMA-accepted WOMP, which outlines the approach to inspection and maintenance activities to verify the ongoing integrity of the wells. An ongoing risk-based process is prescribed under the WOMP. This process involves assessing inspection data, then using this data to re-evaluate risks and define inspection frequencies and determine if maintenance or repair is required.

The approximate frequencies and potential locations of inspection and maintenance activities planned during the Petroleum Activities Program are presented in **Table 3-22**.

Table 3-22: Subsea IMMR activities and frequencies

Activity	Location	Description	Approximate Frequency
Visual inspection	Subsea wells	Routine visual inspection of subsea wells undertaken using a support vessel and ROV (as required).	Three-yearly (once during the life of the EP).
Pressure testing	Subsea infrastructure	Within the scope of this EP, pressure testing is unlikely to be required other than for isolation verification following an event requiring intrusive intervention to rectify.	Five-yearly (0 to once during the life of the EP)[1]
Marine growth removal	Subsea infrastructure Subsea wells	It may be necessary to remove excess marine growth before undertaking subsea inspections, RTM external hull and mooring system inspections, and maintenance activities (**Section 3.8**).	Five-yearly (0 to once during the life of the EP)[1]
Sediment relocation	Subsea infrastructure	If sediment builds up around a flowline or other subsea infrastructure, an ROV-mounted suction pump/dredging unit may be used to relocate sediment to allow inspection/intervention works to be undertaken.	Five-yearly (0 to once during the life of the EP)[1]
Subsea intervention	Subsea infrastructure	Within the scope of this EP, an intervention would only be required to rectify/repair an anomaly or event that has occurred or where proactive intervention for equipment recovery is required for analysis.	Five-yearly (0 to once during the life of the EP)[1]
Corrosion surveys	Subsea infrastructure	Surveys are undertaken using probes (e.g. electrical resistance probes) to assess the effectiveness of corrosion protection (e.g. corrosion protection layers or anode skids).	Five-yearly (0 to once during the life of the EP)[1]
Tree cap replacement	Subsea infrastructure	Not required in this EP unless an inspection found an anomaly or point of concern.	-
Repair	Subsea infrastructure Subsea wells	Repair activities are those required when a subsea system or component is degraded, damaged or has deteriorated to a level outside acceptance limits. Damage sustained may not necessarily pose an immediate threat to continued system integrity, but presents an elevated level of risk to safety and the environment. Subsea repair activities are not anticipated during the Petroleum Activities Program as the wells have been shut in and the subsea system preserved; however, repairs may be undertaken if they are needed to prepare for well intervention or future activities such as permanent plugging for abandonment or decommissioning.	-

[1] *Depending on the timing of the most recent survey, the 5-yearly IMMR activity may or may not fall within the timeframe of the EP.*

3.8.3 Management of IMMR Activities

All planned IMMR activities are completed using a defined framework and process, used to understand the potential environmental impact and if additional regulatory approvals are required. Project information is used 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, an EP Management of Change (MoC) review (**Section 7.6**) may be triggered to confirm if the level of environmental risk warrants revision and resubmission of an EP.

3.8.4 Subsea Chemical Usage

Planned chemical discharges may occur during IMMR activities. However, these are discharged in small volumes (**Table 3-23**). Operational chemicals that may be used on the Enfield subsea infrastructure are selected and assessed using Woodside's chemical selection and assessment procedures, as detailed in **Section 3.13**. Chemicals used in the subsea infrastructure may be released during IMMR activities; these include, but are not limited to:

- control fluid – a water-glycol based control fluid. The subsea control system is an open-loop system that releases hydraulic fluid during valve functioning
- hydrate control – monoethylene glycol (MEG) and triethylene glycol (TEG) are used for hydrate control
- scale inhibitor – scale inhibitor manages and prevents scale build-up within subsea equipment
- biocide – biocides prevent bacterial growth in flowlines and risers that may cause corrosion
- dye – chemical dyes incorporated in the control fluid identify the source of a leak
- acid – sulfamic (or equivalent) acid removes calcium deposits
- oxygen scavenger – oxygen scavenger de-oxygenates the pipeline to prevent corrosion and aerobic bacterial growth
- grout – the material used in grout, mattresses, and rock is typically concrete-based.

Table 3-23: Typical discharge volumes during different IMMR activities

Activity	Typical Discharge
Pressure/leak testing	Chemical dye incorporated into control fluid at ≤1%
Valve functioning	0.5 L to 6 L per valve actuation
Flushing	Residual hydrocarbon or chemical releases volume depends on injection port size, component geometry, and pumping rates
Hot stab change out	Hydrocarbons or control fluid <10 L
Subsea control module change out	A typical release of acid is estimated to be 400 L and of control fluid is estimated to be 10 L
Jumper and umbilical replacement	Typical releases of hydraulic fluid, MEG, and corrosion inhibitor are estimated to be <10 L each
Choke change out	Release of hydrocarbons <10 L and a typical release of MEG is estimated to be 280 L
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.

3.9 Well Intervention

During the preservation period, several wells may be intervened on prior to undertaking permanent abandonment activities at a later date, as subject to a subsequent EP. The decision on whether a well is intervened on will be based on the availability of a MODU or intervention vessel of opportunity. There is no well integrity driver for intervention on any wells. Any intervention activities that may be undertaken would be opportunistic (e.g. a contracted rig/vessel on standby), to setup for a more cost-effective and efficient well abandonment program at a later time. For example, intervention to set additional barriers such as deep-set temporary plugs may open up subsequent final decommissioning/abandonment scope to a wider range of vessels/rigs.

Well intervention involves re-establishing barriers via a MODU or intervention vessel. During well intervention, barriers will be established via the installation of wireline plugs, cement plugs, or a combination of both. The operations will be conducted through a blow-out preventer (BOP) and marine riser or subsea lubricator. The installation of the barriers will require killing the well using kill weight brine and corrosion inhibitors. Production tubing may be cut and recovered to surface to allow the placement of barriers. The casing strings and wellhead will be left in place for future final abandonment. The tubing and annulus fluids will either be re-injected downhole, taken back to the mainland for processing and disposal or treated and disposed of overboard.

3.9.1 Well Intervention Fluids

3.9.1.1 Cement

Cementing operations may be undertaken to either suspend or temporarily plug selected wells. Cementing fluids will generally consist of Portland cement with additives (such as inorganic salts, lignins, bentonite, barite, defoamers and surfactants). Cementing fluids are not routinely discharged to the marine environment, however, volumes of approximately 2 m^3 per well will be released when surplus fluids require disposal after cementing operations at the surface. Cement spacers can be used as part of the cementing process within the well casing to assist with cleaning of the casing sections prior to cement flow-through. The spacers may consist of either seawater or a mixture of seawater and suitable dye. The dye is used to provide a pre-indicator of cement overflow to the seabed surface, to ensure adequate cement height. Such a solution is typically used in turbid or strong current conditions where cement overflow from the casing to the seabed is not visually obvious.

Excess cement may be held on board for use on subsequent wells, provided to the next operator at the end of the well intervention program or, is infrequently discharged to the marine environment below the sea surface, if it does not meet technical requirements as a result of contamination.

3.9.1.2 Well Fluids

Production wells may have residual hydrocarbons in the well and there is the potential that the well intervention fluids will become contaminated with hydrocarbons. If hydrocarbon contamination of the well intervention fluids has occurred, treatment of the fluid will occur on the MODU/intervention vessel, to ensure hydrocarbon content prior to discharge is 1% by volume, or less.

3.9.1.3 BOP Control Fluids

The BOP is required to be regularly function tested when on the well, as defined by legislative requirements. The BOP is also function tested during assembly and maintenance. As part of the testing process, when subsea, small volumes of BOP control fluid (generally consisting of water mixed with a glycol-based detergent or equivalent water based anti-corrosive additive) is released to the marine environment. The hydraulic control fluid used for the operation of the BOP rams is likely to be similar to StackMagic (commercial name), which is fully biodegradable. Approximately 300 to 350 litres of the base chemical diluted in water (at 2% maximum) may be discharged to the marine environment during well intervention.

3.9.1.4 Chemical Use and Discharges

Interventions typically involve the use and discharge of chemicals which may include, but are 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
- cementing fluids and cement spacers of seawater and dye
- small quantities of BOP control fluid.

3.9.2 Unplanned Activities

3.9.2.1 Emergency Disconnect Sequence

An Emergency Disconnect Sequence (EDS) may be implemented if the MODU is required to rapidly disengage from the well. The EDS closes the BOP (i.e. shutting in the well) and disconnects the riser to break the conduit between the wellhead and MODU. Common examples of when this system may be initiated include the movement of the MODU outside of its operating circle (e.g. failure of one or more of the moorings) or the movement of the MODU to avoid a vessel collision (e.g. third-party vessel on collision course with the MODU). EDS aims to leave the wellhead in a secure condition, but will result in the loss of the fluids in the riser following disconnection.

3.10 Project Vessels

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

- A dynamically positioned (DP) PIV supported by two DP support vessels will be used to disconnect the RTM from the anchor chains and remove it from Operational Area 1.
- Support vessels may be used to undertake IMMR activities for preservation, as well as to support RTM removal or well intervention activities.
- A DP intervention vessel may be used for operations to install temporary plugs into wells to support a more cost effective and efficient abandonment program.
- A MODU may be used for well intervention activities depending on availability and suitability for the well location (e.g. water depth). In this EP, the term MODU refers to any mobile offshore drilling unit; options include a semi-submersible moored MODU, DP drillship or DP MODU. All MODU options are risk-assessed and managed under this EP.
- Support vessels including
  - anchor handling tugs (AHTs) required to set anchors and support the intervention vessel and/or MODU during operations
  - activity support vessels for transporting hardware from port/staging area to the Operational Areas, and for general re-supply and support for the PIV, intervention vessel or MODU and support vessels.

All project vessels (MODU, intervention vessel, PIV and support vessels), which have not yet been confirmed, are subject to the Marine Offshore Assurance process and review of the Offshore Vessel Inspection Database. All required audits and inspections will assess compliance with the laws of the international shipping industry, which include safety and environmental management requirements, and maritime legislation including *International Convention for the Prevention of Pollution from Ships 1973* as modified by the Protocol of 1978 (MARPOL) and other International Maritime Organization (IMO) standards.

A description and assessment of support vessel environmental impacts and risks, credible spill scenarios and environmental sensitivities for the activities within the scope of this EP are included in **Section 6**. Some support vessels may be required on an ad-hoc basis to support periods of high activity and will be subject to the above processes. For power generation, vessels may use diesel-powered generators and/or LNG. All vessels will display navigational lighting and external lighting, as required for safe operations. Lighting levels will be determined primarily by operational safety and navigational requirements under relevant legislation, specifically the *Navigation Act 2012*. The MODU and support vessels will be lit to maintain operational safety on a 24-hour basis.

3.10.1 Primary Installation Vessel

The Petroleum Activities Program will require a PIV to support for the RTM removal scope, including disconnection of the RTM from its anchor chains, and towing the RTM from Operational Area 1 to the proposed IAR location. A PIV is yet to be assigned, however, the vessel is likely to have similar specifications to that referenced above in **Section 3.10**

3.10.2 MODU

The Petroleum Activities Program may utilise a MODU instead of or as well as an Intervention Vessel. This may be a moored or DP semi-submersible MODU or drill ship. Typical specifications for these MODU types are provided in **Table 3-24** and **Table 3-25** respectively. These are collectively referred to as MODU for the remainder of the document, unless specific risks for different MODU types have been identified.

Table 3-24: Typical DP MODU specifications

Component	Specification Range
Rig Type/Design/Class	Ultra deepwater semi-submersible MODU
Accommodation	200 persons (maximum persons on board)
Station Keeping	Dynamically positioned
Bulk Mud and Cement Storage Capacity	1000 m^3
Liquid Mud Storage Capacity	2663 m^3
Fuel Oil Storage Capacity	3640 m^3
Drill Water Storage Capacity	3482 m^3

Table 3-25: Typical moored MODU specifications

Component	Specification Range
Rig Type/Design/Class	Semi-submersible MODU
Accommodation	120 to 200 persons (maximum persons on board)
Station Keeping	Minimum eight-point mooring system
Bulk Mud and Cement Storage Capacity	283 to 770 m^3
Liquid Mud Storage Capacity	576 to 2500 m^3
Fuel Oil Storage Capacity	966 to 1400 m^3
Drill Water Storage Capacity	3500 m^3

3.10.3 Intervention Vessel

The intervention vessel has not been assigned but is likely to have similar specifications to that detailed in **Table 3-26**.

A typical intervention vessel will be a dynamically positioned vessel (DP2 Class) equipped with a primary differential global positioning system (DGPS) and an independent secondary DGPS backup system.

Table 3-26: Specifications for typical intervention vessel

Particulars	
Type	DP2 class as a minimum
Draft	Approximately 6.9 m
Dead weight tonnage	Approximately 6500 mt
Accommodation	Approximately 120 personnel
Capacities	
Fuel	Approximately 1000–2200 m^2
Potable water	Approximately 800–1200 m^3
Lube oil	Approximately 35 m^2
Deck area	Approximately 1300–1900 m^2

3.10.4 Support and Other Vessels

During the Petroleum Activities Program, the PIV and MODU/intervention vessel will be supported by other vessels, such as anchor handling and support vessels. Support vessels are required for activities such as transport equipment and materials from port to the PIV or MODU/intervention vessel, and re-supply and support the PIV and the MODU/intervention vessel, during the Petroleum Activities Program.

Support vessels will not anchor within the Operational Areas during the activities due to water depth; instead the vessels use DP systems. The support vessels are also available to assist in implementing the Oil Pollution First Strike Plan (**Appendix H**), should an environmental incident occur (e.g. spills).

3.10.5 Vessel Mobilisation

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

3.11 Project Vessel Support Activities

A variety of materials are routinely bulk transferred from support vessels to the PIV and MODU/intervention vessels including equipment, well intervention fluids and cements. A range of bulk transfer stations and equipment is in place to accommodate the bulk transfer of each type of material. There is also a capacity to bulk transfer well intervention fluids and waste oil to the support vessel, for back loading and disposal on shore.

The loading and back-loading of equipment, materials and wastes will be one of the most common supporting activities conducted during the Petroleum Activities Program. Loading and back-loading is undertaken using cranes to lift materials in appropriate offshore rated containers (ISO tanks, skip bins, containers) to a support vessel.

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

The vessels will also discharge deck drainage from open drainage areas, bilge water from closed drainage areas, putrescible waste and treated sewage and grey water. Hazardous and non-hazardous waste generated are removed from the vessels and disposed of on shore.

3.11.1 Refuelling

The PIV and MODU/intervention vessels will utilise diesel-powered generators for power generation and will be refuelled via support vessels, approximately weekly during activities. This activity will take place within Operational Area 1 during the Petroleum Activities Program. Other fuel transfers that may occur on board the PIV and MODU/intervention vessels include refuelling of cranes, helicopters or other equipment as required (**Section 3.10**). Refuelling will not occur during activities which comprise Operational Area 2.

3.11.2 Mooring Installation and Anchor Holding Testing

MODU mooring uses a system of chains/ropes and anchors, which may be pre-laid before the MODU arrives at the location, to maintain position during intervention activities. A mooring analysis will be undertaken to determine the appropriate mooring system for the Petroleum Activities Program. The mooring analysis will identify whether the mooring system be pre-laid, proof tension values, or using synthetic fibre mooring ropes are appropriate. A pre-laid system can withstand higher sea states, to account for loads associated with cyclones if operations were to occur during cyclone season.

Installation and proof tensioning of anchors involves some disturbance to the seabed. AHTs are used in the deployment and recovery of the mooring system. As part of mooring preparations, anchor holding testing may be conducted at the well locations. Anchor holding testing would be undertaken if Woodside decides that further assurance is required to ensure a robust mooring design.

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

Suction piling may be required and will be reviewed with the MODU contractor.

In addition, tethers may be required for maintaining BOP stability on the Xmas tree. The tethers would also require anchors, that may be pre-laid or installed at the time of BOP connection.

3.11.3 Holding Station: Dynamic Positioning

DP uses satellite navigation and radio transponders in conjunction with thrusters to maintain position at the required location. Information about the position of the project or support vessel is provided via a number of seabed transponders, which emit signals that are detected by receivers on the vessel and used to calculate position. The transponders are typically deployed in an array on the seabed, using clump weights comprising concrete, for the duration of well intervention at each well, and are recovered at the end, generally by ROV. Clump weights are recovered if practicable to do so or may be left in situ.

3.11.4 Holding Station: Mooring Installation and Anchor Hold Testing

Mooring uses a system of chains/ropes and anchors, which may be pre-laid before the Intervention Vessel or MODU arrives at the location, to maintain position during well intervention activities. A mooring analysis will be performed to determine the appropriate mooring system for the Petroleum Activities Program. The mooring analysis will identify whether the mooring system will be pre-laid or set by the Intervention Vessel/rig, proof tension values, or if using synthetic fibre mooring ropes is required. A pre-laid system can generally withstand higher sea states compared to a system that only uses the rig's mooring chain/equipment.

Installation and proof tensioning of anchors involves some disturbance to the seabed. Anchor handling vessels are used to deploy and recover the mooring system. As part of mooring preparations, anchor hold may be tested at the well locations. Anchor hold testing would be performed if Woodside determines that further assurance is required to ensure a robust mooring design. Anchor hold testing activities would occur before the Intervention Vessel and/or MODU arrives on location.

3.12 Helicopters

During the Petroleum Activities Program, crew changes will be performed using helicopters as required. Helicopter operations within the Operational Areas are limited to helicopter take-off and landing on the helideck of the PIV and MODU/intervention vessel. Helicopters may be refuelled on the helideck within Operational Area 1, however, no refuelling will occur during the activities covered under Operational Area 2 (**Section 3.3.1**).

3.13 Assessment of Project Fluids

All chemicals that may be operationally released or discharged to the marine environment by the Petroleum Activities Program were evaluated using a defined framework and set of tools to ensure the potential impacts are acceptable, ALARP and meet Woodside's expectation for environmental performance.

All approved drilling and completion chemicals (including well intervention fluids) are included on the Drilling and Completions – Master Chemical List which is reviewed during a six-month chemical review to drive continuous environmental improvement.

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

All chemical substances 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 with one of two schemes (as shown **Figure 3-14**):

- **Hazard Quotient (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). Used for inorganic substances, hydraulic fluids and pipeline chemicals only.

Hazard Quotient Colour Band	Gold	Silver	White	Blue	Orange	Purple
OCNS Grouping	E	D	C	B	A	
	Lowest Hazard →					Highest Hazard

Figure 3-14: OCNS ranking scheme

Chemicals fall into the following assessment types:

- **No further assessment:** Chemicals with an HQ band of Gold or Silver or an OCNS ranking of E or D with no substitution or product warnings do not require further assessment. Such chemicals do not represent a significant impact on the environment under standard use scenarios and are therefore considered ALARP and acceptable.

- **Further assessment/ALARP justification required:** The following types of chemicals require further assessment to understand the environmental impacts of discharge into the marine environment:
  - Chemicals with no OCNS ranking.
  - Chemicals with an HQ band of white, blue, orange, purple or an OCNS ranking of A,B or C.
  - Chemicals with an OCNS product or substitution warning.

3.13.1 Further Assessment/ALARP Justification

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

3.13.1.1 Alternatives

If no environmental data are available for a chemical or if the environmental data do not meet the acceptability criteria outlined below, potential alternatives for the chemical will be investigated, with preference for options with an HQ band of Gold or Silver, or are 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) will be considered for the specific context and implemented where relevant to ensure the risk is ALARP and acceptable.

3.13.1.2 Decision

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

3.13.2 Ecotoxicity

Chemical ecotoxicity is assessed using the criteria used by CEFAS to group chemicals based on ecotoxicity results (**Table 3-27**). If a chemical has an aquatic or sediment toxicity within the criteria for the OCNS grouping of D or E this is considered acceptable in terms of ecotoxicity.

Table 3-27: CEFAS OCNS grouping based on ecotoxicity results

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

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

3.13.3 Biodegradation

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

CEFAS categories biodegradation into the following groups:

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

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

3.13.4 Bioaccumulation

The bioaccumulation of chemicals is assessed using the CEFAS bioaccumulation criteria, which align with the categorisation outlined in the Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline (DMP 2013). Bioaccumulation is determined by calculating the partitioning of the substances between water and n-octanol (LogPow) or experimentally in a full bioconcentration test utilising either fish or a bivalve mollusc (OECD 305 and ASTM E1022) to give an Experimental Bioconcentration Factor (BCF).

The following guidance is used by CEFAS:

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

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

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

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

4 DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Overview

In accordance with Regulation 13(2) and 13(3) of the Environment Regulations, a description of the existing environment that may be affected by the activity (planned and unplanned activities, as defined in **Section 2.4.2** and described in **Section 3**) including details of the particular relevant values and sensitivities of the environment, is provided in this section, and has been used for the purposes of 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 potential spatial extent of surface, dissolved and entrained hydrocarbons at concentrations above ecological impact thresholds, in the event of the worst-case credible spill. The ecological impact thresholds used to delineate the EMBA are defined in **Table 4-1** and **Section 6.6.2.1**. The worst-case credible spill scenario for this EP is loss of well containment. The EMBA also includes any areas that are predicted to experience shoreline accumulation of hydrocarbons at or above threshold concentrations (100 g/m^2).

Woodside recognises that hydrocarbons may be visible beyond the EMBA at lower concentrations than the ecological impact thresholds defined in **Section 6.6.2.1**. These visible hydrocarbons are not expected to cause ecological impacts. In respect of this, an additional socio-cultural EMBA is defined as the potential spatial extent within which socio-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-cultural EMBA are shown in **Figure 4-1** and described in **Table 4-1**.

Note: Each 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.

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

Hydrocarbon Type	EMBA[1]	Socio-cultural EMBA[1]	Planning Area for Scientific Monitoring
Surface	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.	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).	
Dissolved	50 ppb This is a highly conservative threshold; the lowest 'no effect concentration' (NOEC) observed in Woodside's ecotoxicity testing for Enfield Crude is 340 ppb (refer to **Section 6.6.2.1**). 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.		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

Hydrocarbon Type	EMBA[1]	Socio-cultural EMBA[1]	Planning Area for Scientific Monitoring
Entrained	100 ppb The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for water-accommodated fractions (WAF) of oil hydrocarbons (**Table 6-8**). Entrained oil hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved oil hydrocarbons. Therefore, 100 ppb is a highly conservative threshold; the lowest 'no effect concentration' (NOEC) observed in Woodside's ecotoxicity testing for dissolved Enfield Crude is 340 ppb (refer to **Section 6.6.2.1**). 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 represents the level at which socio-cultural impacts may occur.		contacted by hydrocarbons at this threshold **Table 5-1**.

[1] *Further details including the source of the thresholds used to define the EMBA in this table are provided in **Section 6.6.2.1**.*

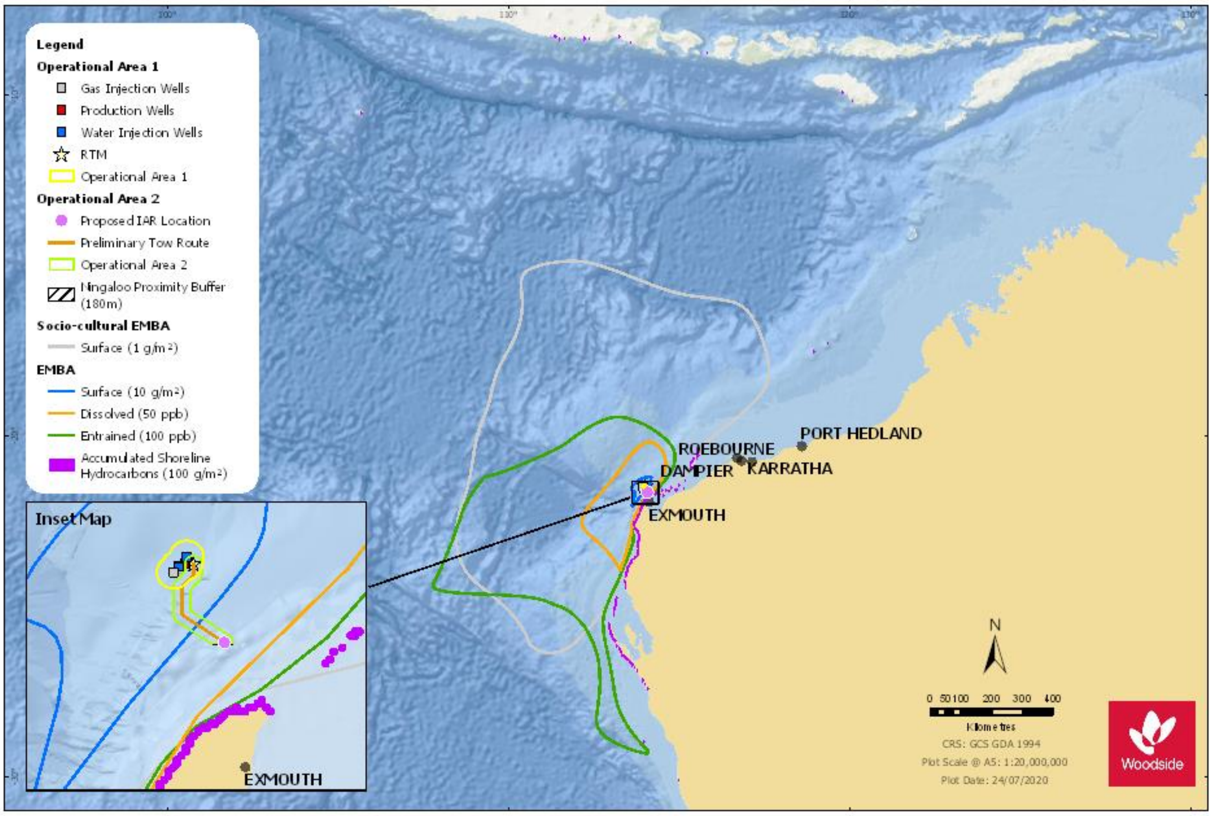


Figure 4-1: Operational Areas, EMBA, and socio-cultural EMBA

4.2 Regional Context

The Operational Areas are located in Commonwealth waters within the Northwest Province and the Central Western Shelf Transition, in water depths ranging from 400 to 600 m for Operational Area 1 and 130 to 400 m for Operational Area 2. The Northwest Province and the Central Western Shelf Transition are part of the wider North-west Marine Region (NWMR) (**Figure 4-2**) as defined under the Integrated Marine and Coastal Regionalisation of Australia (National Oceans Office and Geoscience Australia 2005).

The Northwest Province encompasses Commonwealth waters of the continental slope between Exmouth and Port Hedland, covering 16.7% of the North-west Marine Region at depths predominantly between 1000 and 3000 m. The Northwest Province is characterised by the following biophysical features (Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC], 2012a; Department of Environment, Water, Heritage and the Arts [DEWHA], 2008):

- continental slope, situated between the shallower continental shelf and the abyssal plain
- several topographic features such as the Exmouth Plateau, terraces and canyons (several of which are associated with key ecological features (KEFs); refer to **Section 4.6.7**)
- surface ocean circulation is strongly influenced by the Indonesian Throughflow (ITF) via the Eastern Gyre and the Leeuwin Current. During the summer when the ITF is weaker, south-west winds cause intermittent reversals in currents. These events may be associated with occasional weak, shelf upwellings
- transitional climatic conditions between dry tropics to the south and humid tropics to the north
- strongly seasonal winds and moderate tropical cyclone activity
- surface waters are tropical year-round and highly stratified during summer months (thermocline occurring at water depths between 30 and 60 m). In winter, surface waters are well mixed with thermoclines occurring deeper around 120 m depth
- transitional boundary between tropical and temperate marine biological communities
- relatively high endemism of demersal fish species associated with continental slope
- pelagic food webs, potentially enhanced by upwelling associated with seabed features, support larger fauna such as fishes, sharks and dolphins
- soft sediment seabeds dominate benthic habitats, with associated epifauna communities such as filter and deposit feeders
- Presence of significant migratory routes, resident populations, breeding and/or feeding grounds for a number of EPBC Act listed threatened and migratory marine species, including humpback whales, pygmy blue whales, marine turtles, whale sharks and seabirds.

The Central Western Shelf Transition is the smallest bioregion in the NWMR, located entirely on the continental shelf between the North West Cape and Carnarvon. The region includes both State and Commonwealth waters, covering 9698 km^2 at depths between 0 and 80 m. The Central Western Shelf Transition bioregion is characterised by these biophysical features (DEWHA, 2008):

- strongly influenced by interactions between the Leeuwin Current, the Leeuwin Undercurrent and the Ningaloo Current
- transitional boundary between tropical and temperate marine biological communities
- the Ningaloo Reef is the most significant geomorphic feature of the bioregion
- between September and mid-April, inner shelf waters are dominated by the northward-flowing Ningaloo Current. Further inshore, a wave, wind and tidally driven flow dominates
- the predominantly southward flowing surface currents bring tropical Indo–Pacific species into this bioregion, but the influence of the northward flowing Leeuwin Undercurrent also transports temperate species from more southern areas into the bioregion
- relatively biologically productive environment due to the narrowness and shallowness of the area and the interaction of slope and shelf-edge processes

- encompasses significant migratory routes, resident populations, breeding and/or feeding grounds for a number of EPBC Act listed threatened and migratory marine species, including marine turtles, dugongs, dolphins, whale sharks and manta rays
- encompasses the benthic habitats of coral reefs, seagrass, macroalgae, non-coral benthic invertebrates
- comprises mainly sandy sediments
- encompasses the shoreline habitats of mangroves, intertidal platforms and rocky shorelines

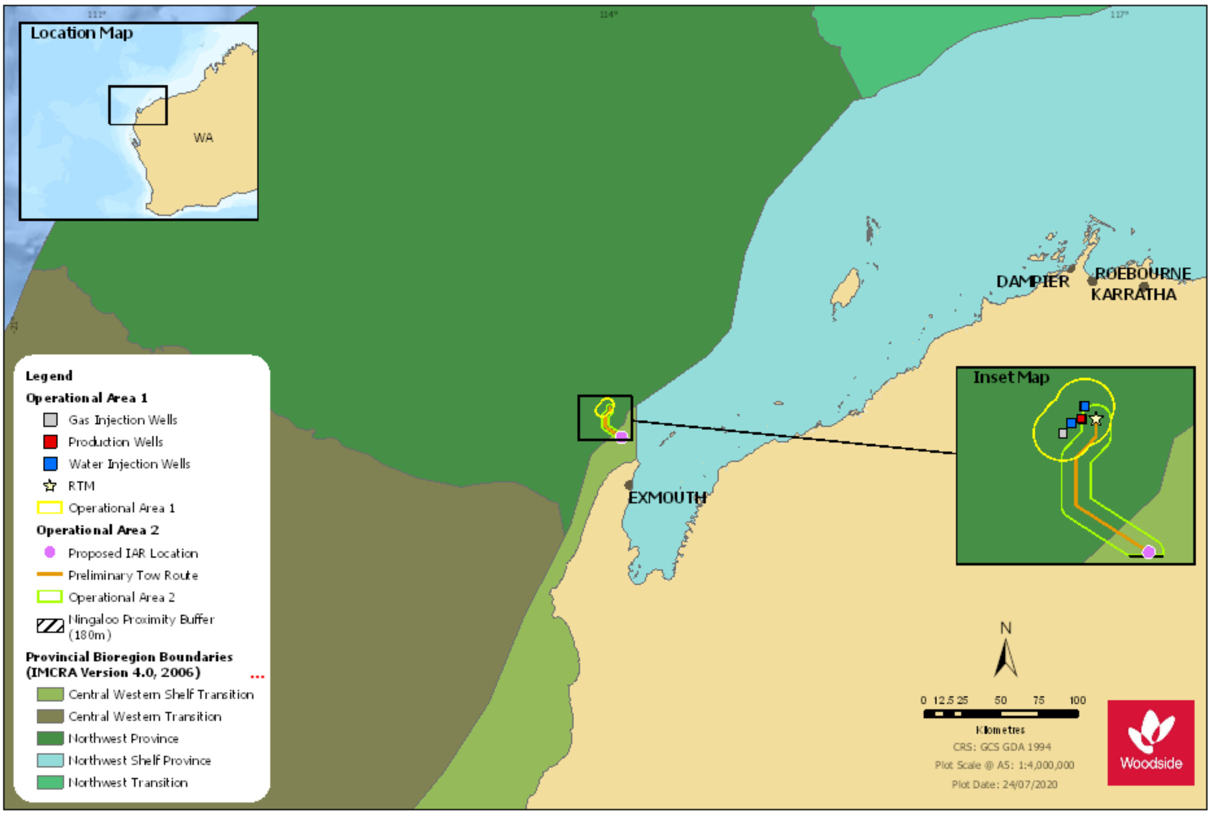


Figure 4-2: North-west Marine Region and the location of the Operational Areas

(IMCRA Version 4.0, 2006)

4.3 Physical Environment

4.3.1 Climate and Meteorology

4.3.1.1 Seasonal Patterns

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

Air temperatures in the region, as measured at the Learmonth airport meteorological station (about 64 km from the Operational Areas), indicate maximum average temperatures during summer of 37.5 °C and minimum temperatures of 12.2 °C in winter (Bureau of Meteorology n.d.). The NWMR experiences a tropical monsoon climate, with distinct wet (October to April) and dry (May to September) seasons (Pearce et al., 2003). Rainfall in the NWMR typically occurs during the wet season (summer), with highest falls observed during late summer and autumn (Bureau of

Meteorology, n.d.), often associated with the passage of tropical low pressure systems and cyclones (Pearce et al., 2003). Rainfall outside this period is typically low.

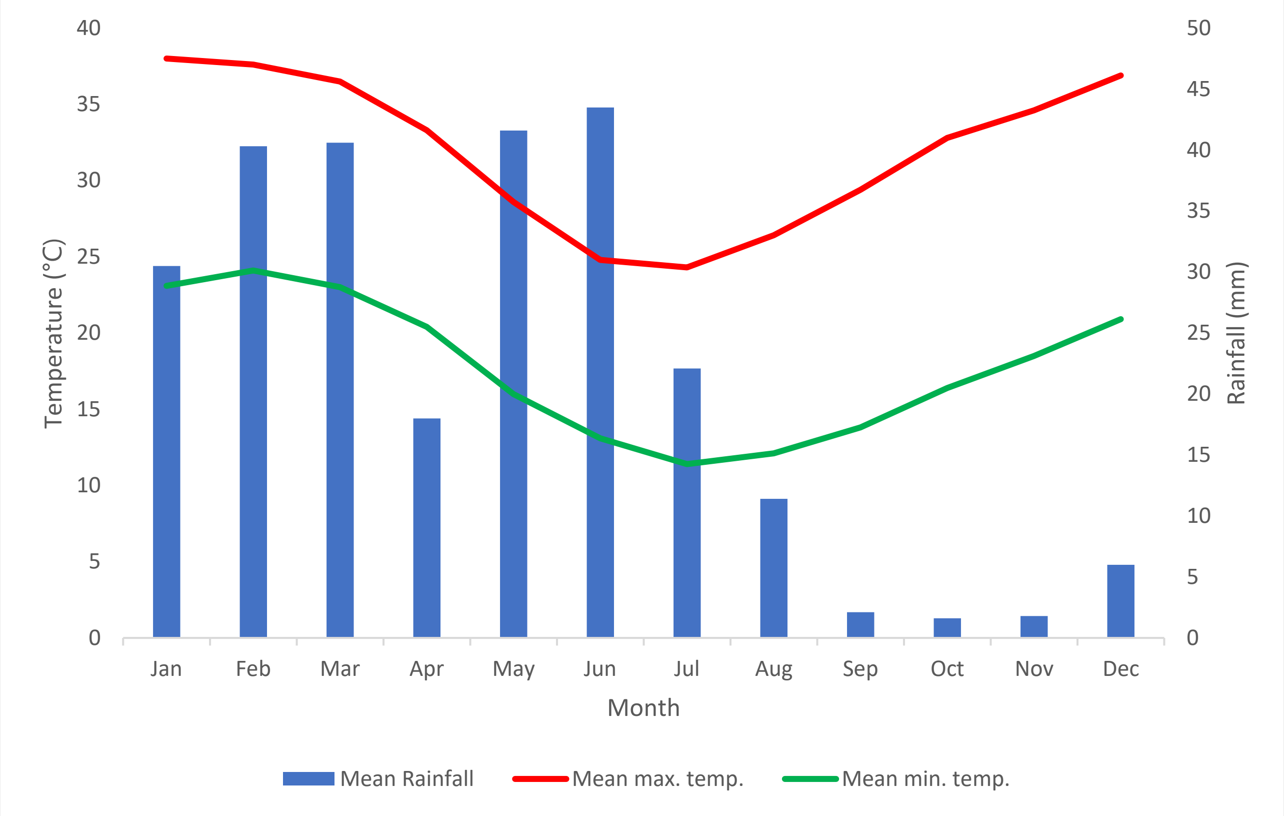


Figure 4-3: Mean monthly average maximum temperature, average minimum temperature, and average rainfall from January 1946 to July 2019 from Learmonth Airport meteorological station

(data from Bureau of Meteorology, n.d.)

4.3.1.2 Wind

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

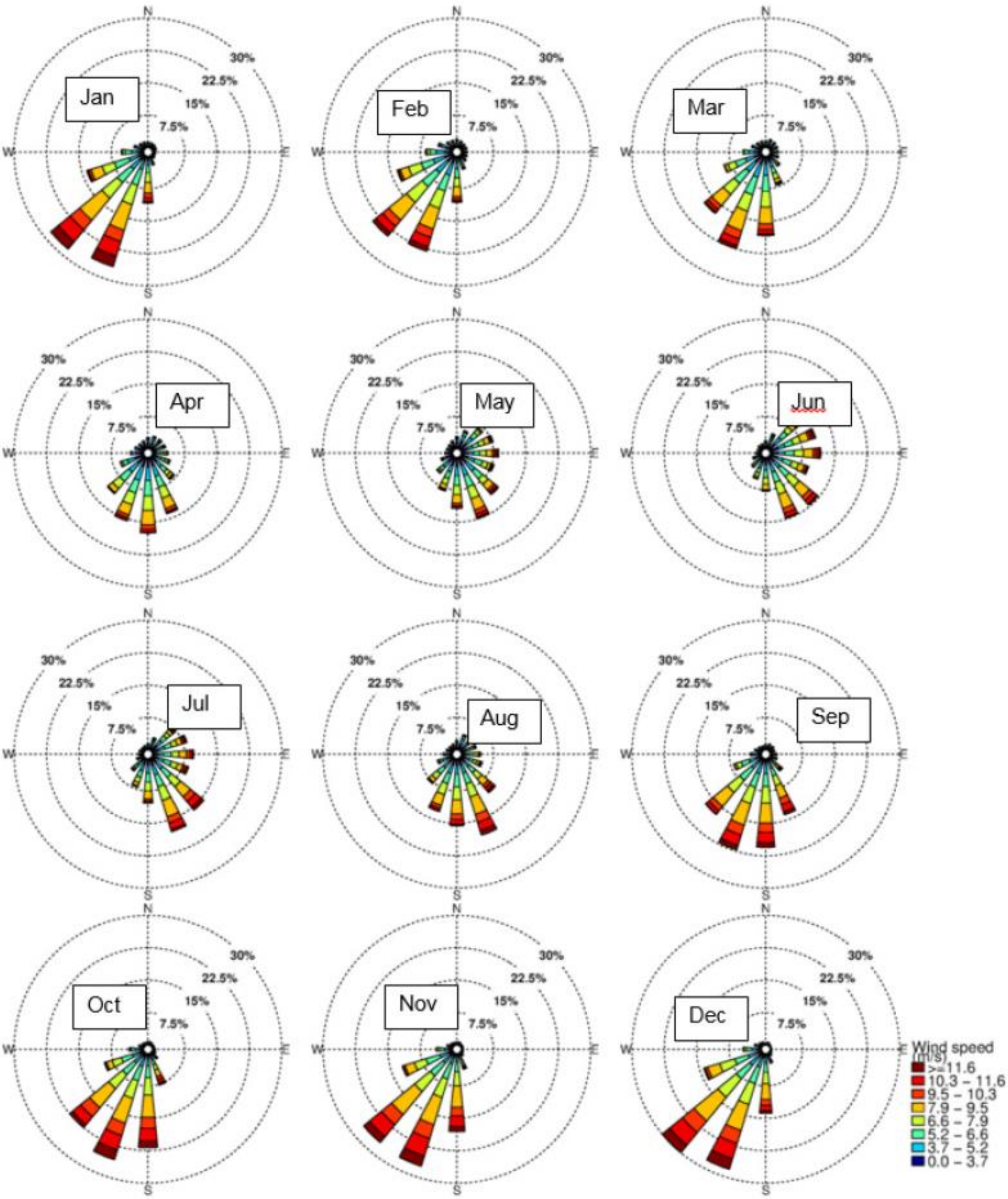


Figure 4-4: Monthly wind roses from WA-28-L

(Woodside Energy Limited 2016)

4.3.1.3 Tropical Cyclones

Tropical cyclones are a relatively frequent event in the region, with the Pilbara coast experiencing more cyclonic activity than any other region of the Australian mainland coast (BoM, n.d.). Tropical cyclone activity can occur between November and April and is most frequent during January to March, with an annual average of approximately one storm per month. The cyclone season officially runs from November to April each year although cyclones also occur outside this period (BoM, n.d.). Significant storm surge is associated with the passage of a cyclone, which can result in very high tides and coastal flooding (BoM, n.d.; Pearce et al., 2003).

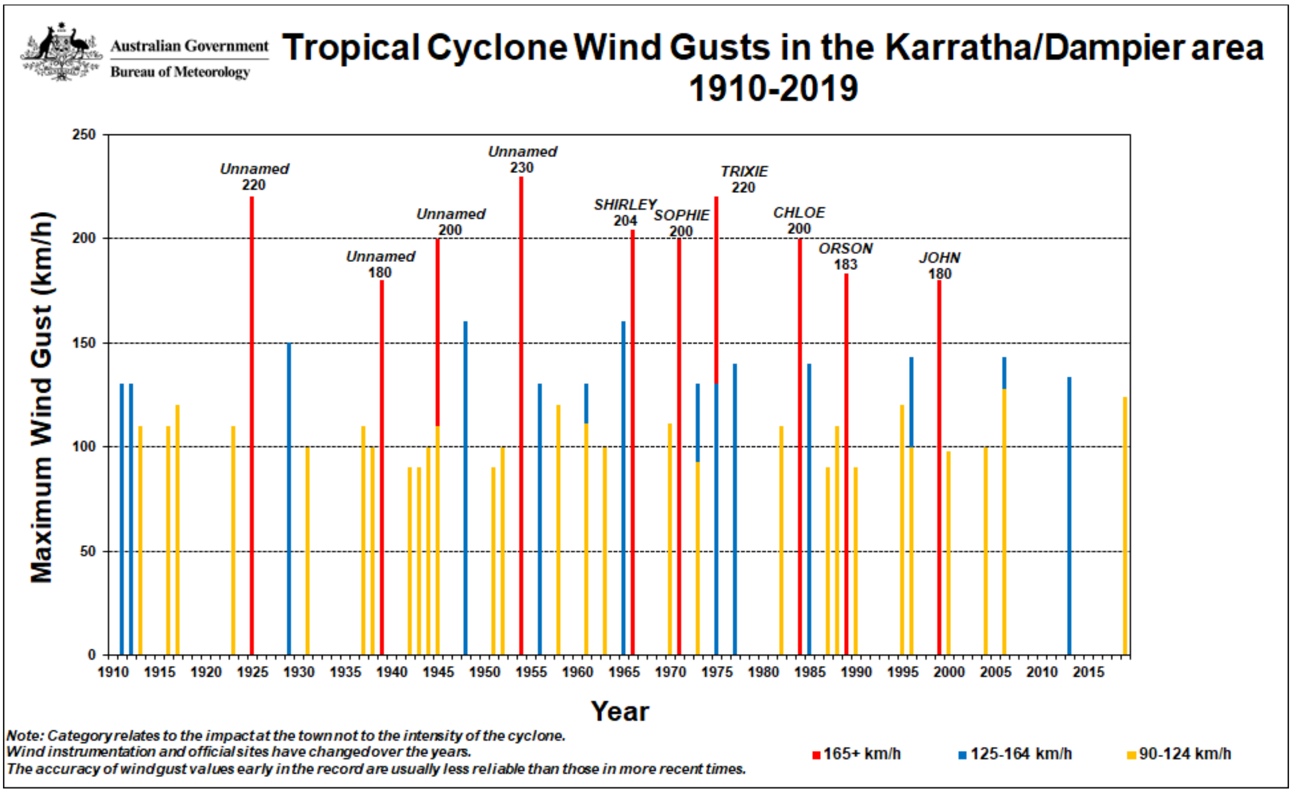


Figure 4-5: Tropical cyclone activity in the Dampier/Karratha region 1910–2017

Source: BoM, n.d.

4.3.2 Oceanography

4.3.2.1 Currents and Tides

Currents in the region consist of local currents driven by winds and tides, superimposed on synoptic scale geostrophic currents. Local winds generate stress on the water surface, forcing the surface layer in the general direction of wind movement, but with an offset (15–45%) in an anti-clockwise direction (Coriolis effect). In the open ocean, sustained winds result in wind-forced currents of approximately 3% of the wind speed (Holloway and Nye, 1985). Thus, a sustained wind of 20 knots may force surface currents of up to 0.6 knots. Wind patterns in the region are described in **Section 4.3.1.1** and shown in **Figure 4-4**.

Currents in the vicinity of the Operational Areas (as measured in WA-28-L are between 0.15 and 0.24 m/s on average throughout the year. Surface currents are, on average, faster during winter months, which corresponds with higher Leeuwin Current flow. Currents closer to the seabed are slower on average and less variable seasonally than surface currents (Woodside, 2016). Surface currents exhibit seasonal directionality, with flow to the south-west characterising March to June, with currents more variable outside this period (Woodside, 2016). This is consistent with stronger Leeuwin Current flow during winter months, with more variable currents driven by local wind stress during periods of weaker Leeuwin Current flow.

The large-scale ocean circulation of the NWMR is primarily influenced by the ITF (Meyers et al., 1995; Potemra et al., 2003), and the Leeuwin Current (Batteen et al., 1992; Godfrey and Ridgway 1985; Holloway and Nye, 1985; James et al., 2004; Potemra et al., 2003). Both currents are significant drivers of the NWMR ecosystems. The currents are driven primarily by pressure differences between the equator and the higher density cooler and more saline waters of the Southern Ocean, and are strongly influenced by seasonal change and El Niño and La Niña episodes (DSEWPaC, 2012a). In the Northwest Province region, the Leeuwin Current may also incorporate Indian Ocean water from the Eastern Gyral Current (D'Adamo et al., 2007).

The Leeuwin Current flows southward along the edge of the continental shelf and is primarily a surface flow (up to 150 m deep) and is strongest during winter (Cresswell, 1991). The Ningaloo Current flows in the opposite direction, running northward along the outside of Ningaloo Reef and across the inner shelf from September to mid-April (**Figure 4-6**). In March, on the termination of the Northwest Monsoon, an 'extended Leeuwin Current' currently known as the Holloway Current develops, flowing to the south-east along the North West Shelf Province (DSEWPaC, 2012a).

In addition to the synoptic-scale current dynamics, tidally driven currents are a significant component of water movement in the NWMR. Tide measurements at the Vincent field indicate that tides in the Operational Areas are semi-diurnal, with a tidal range of 2.1 m (Woodside 2016). Tides in the wider NWMR are semi-diurnal and have a pronounced spring-neap cycle, with tidal currents flooding towards the south-east and ebbing towards then north-west (Pearce et al., 2003). The NWMR exhibits a considerable range in tidal height, from microtidal ranges (<2 m) south-west of Barrow Island to macrotidal (>6 m) north of Broome (Brewer et al., 2007, Holloway 1983). Storm surges and cyclonic events can also significantly raise sea levels above predicted tidal heights (Pearce et al., 2003). Wind driven currents become dominant during the neap tide (Pearce et al., 2003).

In summer, the stratified water column and large tides can generate internal waves over the upper slope of the NWMR (Craig 1988). As these waves pass the shelf break at approximately 125 m depth, the thermocline may rise and fall by up to 100 m in the water column (Holloway 1983, Holloway and Nye 1985). Internal waves of the NWMR are confined to water depths between 70 and 1000 m and the dissipation energy from such waves can enhance mixing in the water column (Holloway et al., 2001).

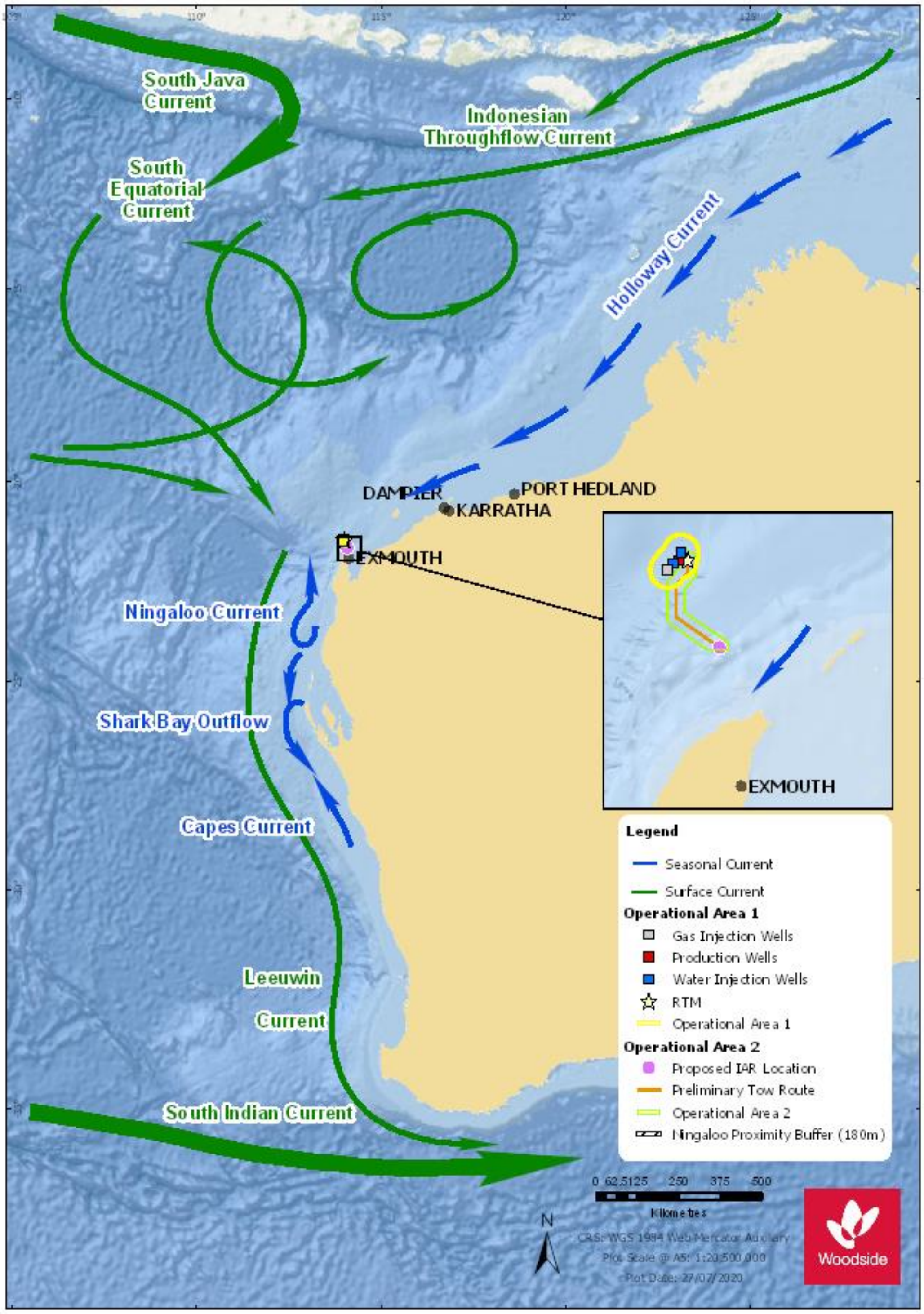


Figure 4-6: Large-scale ocean circulation of the North-west Marine Region including the location of the Indonesian Throughflow and other currents of significance

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

4.3.2.2 Wave Height

Waves at the *Ngujima-Yin* FPSO (approximately 4 km from the Operational Areas) are typically bi-modal, comprising locally generated wind waves and oceanic swells generated in the Southern Ocean (Woodside Energy Limited 2016). Non-cyclonic wave heights at the FPSO are on average 2.15 m, although the maximum non-cyclonic wave height recorded was 5.71 m (Woodside Energy Limited, 2016).

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

4.3.2.3 Seawater Characteristics

The offshore, oceanic seawater characteristics of the Operational Areas exhibit seasonal and water depth variation in temperature and salinity being influenced by currents in the region (see Current and Tides above). Surface waters are relatively warm year round due to the tropical water supplied by the ITF and the Leeuwin Current, with temperatures varying between a maximum of 30°C and a minimum of 23°C (Woodside Energy Limited, 2016). Temperatures in deeper waters (345 m below sea level) are less variable, ranging between 18 and 12 °C year round.

A recent environmental survey of the Enfield canyon commissioned by Woodside indicated the water column has temperature and density gradients consistent with other locations in the region, with a well-mixed surface layer (<100 m water depth) lying above a distinct halocline between 100 and 300 m (BMT Oceanica, 2016). Below the halocline, salinity is relatively isohaline, with water temperature decreasing with depth. On the basis of temperature and salinity data, three potential water bodies (tropical surface water, South Indian central water and Antarctic intermediate water) were identified in the vicinity of the Operational Areas.

During summer, the water column in the Northwest Province is thermally stratified due to surface heating, with the thermocline occurring between 30 and 60 m water depth (James et al., 2004). Surface waters are relatively well mixed in winter due to a weaker thermal gradient and persistent south-easterly winds promoting mixing, with the thermocline occurring at around 120 m depth (DSEWPaC, 2012a; James et al., 2004).

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

Turbidity is primarily influenced by sediment transport by oceanic swells and primary productivity (Pearce et al., 2003). Upwelling of nutrient-rich waters may increase phytoplankton productivity in the photic zone, which may increase local turbidity (Wilson et al., 2003). In nearshore areas, turbidity is highly variable due to storm runoff, wind generated waves and large tidal ranges (Pearce et al., 2003). Periodic events, such as major sediment transport associated with tropical cyclones, may influence turbidity on a regional scale (Brewer et al., 2007). During summer, the Leeuwin Current typically weakens and the Ningaloo Current develops, facilitating upwellings of cold, nutrient-rich waters up onto the NWS (DSEWPaC 2012a). Other areas of localised upwelling in the NWMR include the Wallaby Saddle and Exmouth Plateau, where these seabed topographical features may force the surrounding deeper, cooler, nutrient-rich waters up into the photic zone (DSEWPaC 2012a). Given the upper continental slope location, water quality in the Operational Areas is expected to be consistent with the wider Northwest Province region.

4.3.3 Bathymetry

The Operational Areas are located in waters about 130 to 600 m deep on the upper continental slope (water depth is between 400 and 600 m in Operational Area 1 and 130 to 400 m in Operational Area 2). Bathymetry data acquired within the Operational Area 1 indicate the seabed is relatively flat and featureless, although the subsea infrastructure in the western portion of the Operational Area 1 overlaps the Enfield Escarpment (**Figure 4-7**). The Enfield Escarpment is approximately 50 m in height, with a relatively steep slope in comparison to the surrounding seabed. The Enfield canyon lies in the southern portion of the Operational Area 1 and comprises the North and South Enfield Canyons (**Figure 4-7**) (herein referred to as the Enfield Canyon).

The Enfield Canyon is a tributary of the Cape Range Canyon and exhibits relatively low topographic relief (20–30 m), with only isolated boulders (sometimes greater than three metres in height) observed (BMT Oceanica, 2016).

The tow route in Operational Area 2 overlaps the Continental Slope Demersal Fish Communities and Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEFs; however, these features do not overlap the proposed IAR location. In January 2020, Woodside carried out a survey campaign to investigate the seafloor characteristics at the proposed IAR location within Operational Area 2. The survey collected data on bathymetry, spatial derivatives, sedimentology, benthic habitats, and fish populations at the proposed IAR location. This information was used to further assess the suitability of the proposed location for an artificial reef.

The seafloor throughout the proposed IAR location was determined to be generally flat (~1°) and featureless. Water depths increase from ~133 m below LAT in the south-eastern corner of the area, to 199 m below LAT in the north-eastern corner. No small (2–5 m) features were able to be discerned from the survey data, and no medium to large (>5 m) features are present in the survey area, exception for two elongated depressions (4 m deep relative to the seafloor) in the north-western region of the area.

More broadly, the NWS encompasses more than 60% of the continental shelf in the NWMR (Baker et al., 2008), and gradually slopes from the coastline to the shelf break at the edge of the region and includes water depths of 0–200 m. Approximately half of the NWS is located in water depths of 50 to 100 m (DEWHA, 2008). The NWS includes a number of seafloor features including submerged banks and shoals, and valley features that are thought to be morphologically distinct from other features of these types in different regions of the NWMR (DEWHA, 2008). At approximately 120 m depth contour, a broad scale terrace of gradients between 5 and 20 degrees at the start of the outer shelf represents a paleo-shoreline and marks an important divide between shelf carbonate sands and cemented carbonates and the finer, less cemented slope materials offshore. This includes the Ancient Coastline at 125 m depth contour (Ancient Coastline KEF) which is about 8 km from the Operational Area 2 at its closest point.

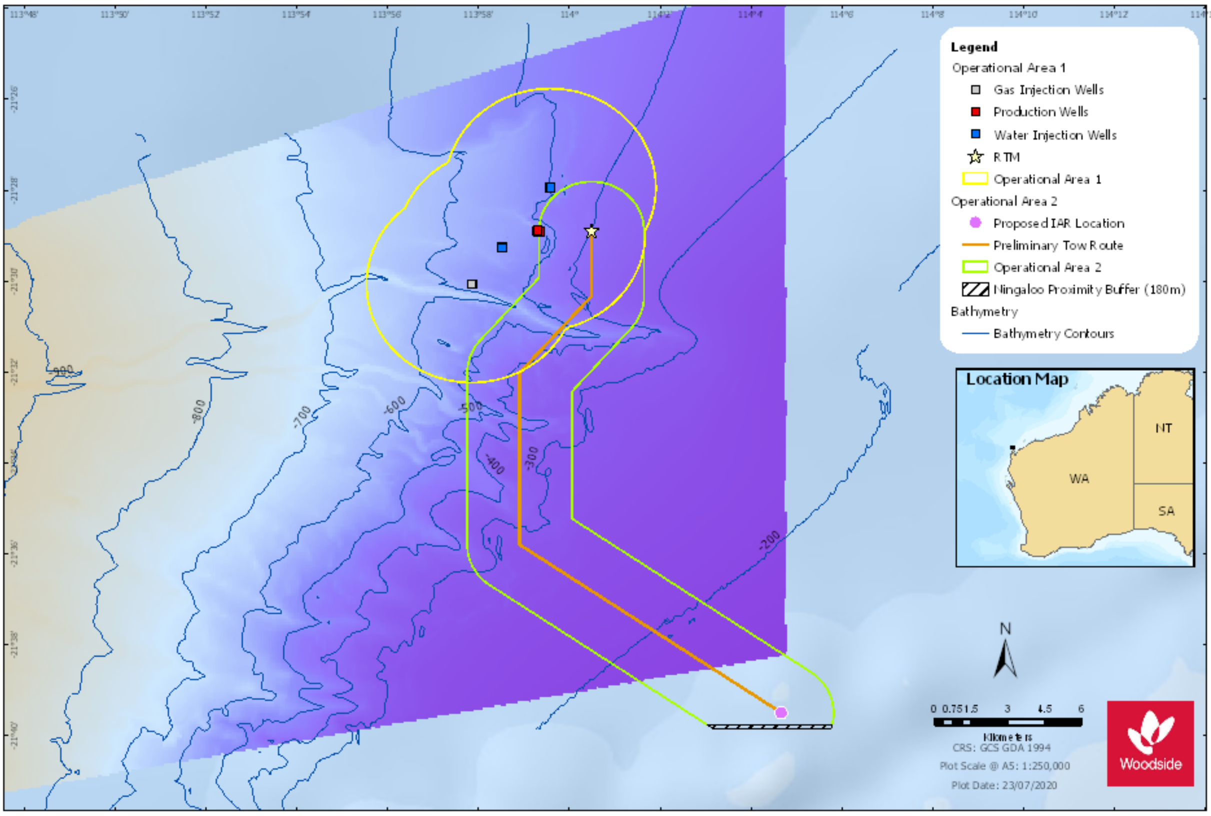


Figure 4-7: Bathymetry and seabed features of the Operational Areas

4.3.4 Marine Sediment

Sediment investigations within the Enfield Canyon (Operational Area 1), based on acoustic data, indicated that the upper slope habitat (in depths of approximately 200 to 500 m) is generally composed of coarser and/or more consolidated sediments as compared to the mid-slope (500 to 1000 m) (BMT Oceanica, 2016). Sediments within the Enfield Canyon where they overlap with the Operational Areas were found to comprise sand, silt, clays and fines (BMT Oceanica, 2016). Isolated areas of hard substrate within the Enfield Canyon were characterised by isolated boulders, and found to be featureless (BMT Oceanica 2016). Sediment quality in the Enfield Canyon was high, with most potential contaminants (metals and hydrocarbons) below recognised guidelines for sediment quality (BMT Oceanica, 2016).

Seabed sediments and subsea geology at the proposed IAR location have been inferred from sonar data and physical samples, which were collected during surveys undertaken by Woodside in 2020, to be fine silty sand between 2 and 20 m thick, overlaying a hard, consolidated subsurface layer. The benthic habitats observed almost entirely comprise bare silty sand. Hard substrates in the broader region can host more diverse benthic communities. Hard substrate may be associated with the Ancient Coastline at 125 m depth contour KEF (about 8 km away from Operational Area 2) (**Section 4.6.7**).

Seabed sediments of the continental slope in the Northwest Province are generally dominated by carbonate silts and muds, with sand and gravel fractions increasing closer to the shelf break on the upper slope (Baker et al., 2008). Sediments of the Northwest Province are characterised by fine to medium sediment (silts and sands), with patches of coarser sediments (shells/gravels) (Woodside Energy Limited, 2005). Sediment composition was shown to comprise a gradient of finer sediments with increasing depth, and the area is interspersed with smaller patches of more consolidated, coarser sediment and limited rocky outcrops associated with steeper slope areas (Woodside Energy Limited, 2005).

Continental shelf areas of the northern Ningaloo Marine Park (Commonwealth waters) were surveyed in January 2018 using multibeam acoustic sonar, towed video and a towed still camera to characterise and quantify seabed habitats in the Marine Park and adjacent waters (Babcock et al., 2018). This study included the seabed adjacent to Operational Area 2, to a maximum water depth of 130 m. Five habitat types were delineated in the study area (90–130 m water depths), with the majority (89%) being soft substrata ranging from silty to sand and shell dominated (Babcock et al., 2018). The closest hard substrates to the proposed IAR location are areas of gravel and boulders about 2.2 km distance away to the south-east.

Sediment quality in the NWS is generally high, except for areas in close proximity to ports (Department of Environment and Conservation, 2006), where elevated concentrations of metals and hydrocarbons may occur.

4.3.5 Air Quality

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

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

4.4 Biological Environment

4.4.1 Shipping

The NWMR supports significant commercial shipping activity, the majority of which is associated with the mining and oil and gas industries (**Figure 4-8**).

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. The fairways are not mandatory but AMSA strongly recommends commercial vessels remain within the fairway when transiting the region. It is noted that none of these fairways intersect with the Operational Areas; the nearest fairway is approximately 40 km north-west of Operational Area 1 (**Figure 4-8**). Vessel tracking data suggest shipping is concentrated to the north-east of the Operational Area, which is likely associated with ports.

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

- Exmouth (about 33 km south of Operational Area 2, beyond EMBA)
- Onslow (about 105 km east of Operational Area 2, beyond EMBA)
- Barrow Island (about 150 km north-east of Operational Area 1, beyond the EMBA).

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

- international bulk freighters/tankers including mineral ore, hydrocarbons (LNG, liquefied petroleum gas, condensate) and salt carriers
- domestic support/supply vessels servicing offshore facilities and Barrow Island development
- construction vessels/barges/dredges

- offshore survey vessels
- commercial and recreational fishing vessels.

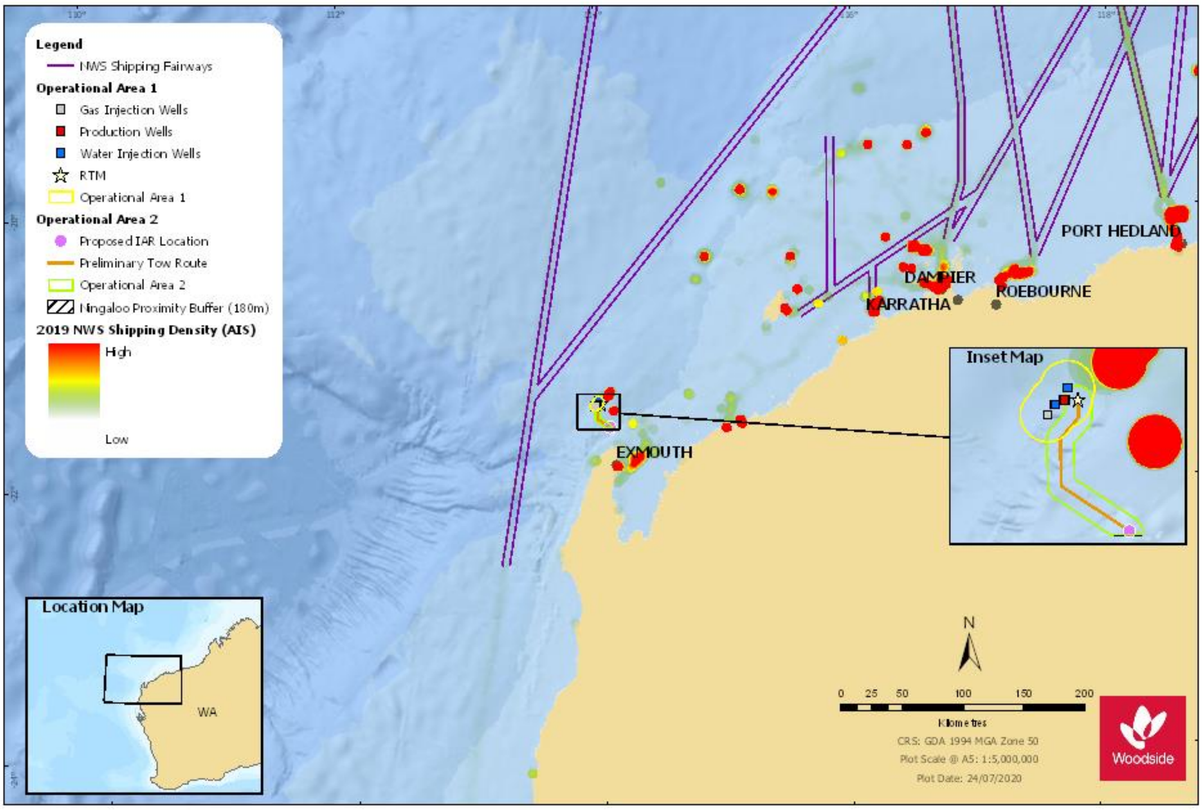


Figure 4-8: Vessel density map for the Operational Areas, derived from AMSA satellite tracking system data (vessels include cargo, LNG tanker, passenger vessels, support vessels, and others/unnamed vessels)

4.4.2 Habitats

4.4.2.1 Critical Habitat – EPBC Listed

No Critical Habitats or Threatened Ecological Communities, as listed under the EPBC Act occur within the Operational Areas or EMBA, as indicated by the EPBC Act Protected Matters Search Tool (PMST) reports provided in **Appendix C**.

4.4.2.2 Marine Primary Producers

Sea floor communities in deeper shelf waters receive insufficient light to sustain ecologically sensitive primary producers such as seagrasses, macroalgae or reef-building corals. Given the depth of water within the Operational Areas (approximately 130 to 600 m), these benthic primary producer groups will not occur in the Operational Areas but are present within the EMBA.

Coral Reef

Coral reef habitats have a high diversity of corals and associated fish and other species of both commercial and conservation importance. Coral reef habitats are an integral part of the marine environment within the NWMR. Site surveys at the proposed IAR location (~150 m water depth) did not detect any hard substrates or hard coral dominated communities. The nearest hard coral communities (e.g. Helby Banks [Turner et al., 2018]) are located at least 11 km from the IAR site. Shallow coral reef habitats within the EMBA include those within the Muiron Islands Marine

Management Area (15 km south-east of Operational Area 2) and the Houtman Abrolhos Islands Australian Marine Park (560 km south of Operational Area 2).

Hard corals in the region typically have a distinct spawning season, with most species spawning during autumn (March–April) (Rosser and Gilmour 2008, Simpson et al., 1993). Further information on locations with coral reef habitats is provided in **Section 4.6**.

Seagrass Beds/Macroalgae

Seagrass beds and benthic macroalgae reefs are a main food source for many marine species, and 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 due to large tidal movement, high turbidity, large seasonal freshwater runoff and cyclones. They are widely distributed in shallow coastal waters that receive sufficient light to support seagrasses and macroalgae. No seagrass beds or macroalgae occur in the Operational Areas, as the seabed depth received insufficient photosynthetically active radiation to support such communities. However, seagrass beds and macroalgae habitats are present in the EMBA including the Ningaloo Coast, Muiron Islands, Shark Bay and Houtman Abrolhos Islands. Further information on locations with seagrass and macroalgae habitats is provided in **Section 4.6**.

Mangroves

Mangrove systems provide complex structural habitats that act as nurseries for many marine species as well as nesting and feeding sites for many birds, reptiles and insects (Robertson and Duke, 1987). Mangroves also maintain sediment, nutrient and water quality within habitats and minimise coastal erosion. These coastal habitats are not found within or adjacent to the Operational Areas, but can be found in the EMBA along the Ningaloo Coast, Exmouth Gulf and Shark Bay.

4.4.2.3 Lifecycle Stages 'Critical' Habitats

Spawning, Nursery, Resting and Feeding Areas

Critical habitats for species conservation include spawning, nursery, resting and feeding areas. These critical habitats will vary for each species. Any critical habitat for protected species within the Operational Areas, as identified by the EPBC Act Protected Matters search (**Appendix C** is outlined below in **Section 4.4.3** within the relevant species sections or within **Section 4.6**.

Migration Corridors

Many marine species, including cetaceans, whale sharks, seabirds and shorebirds migrate seasonally between feeding, breeding and nursery habitats using migration corridors. Migration corridors for protected species that pass through the Operational Areas and EMBA are outlined below in **Section 4.4.3**.

4.4.2.4 Other Communities/Habitats

Plankton

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

Within the EMBA, peak primary productivity 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 (Department of Conservation and Land Management [CALM], 2005), with periodic upwelling throughout the year.

Pelagic and Demersal Fish Populations

Fish species in the NWMR (including the Operational Areas and much of the EMBA) comprise small and large pelagic fish, as well as demersal species. Small pelagic fish inhabit a range of marine habitats, including inshore and continental shelf waters. They feed on pelagic phytoplankton and zooplankton and represent a food source for a wide variety of predators including large pelagic fish, sharks, seabirds and marine mammals (Mackie et al., 2007). Large pelagic fish in the NWMR include commercially targeted species such as mackerel, wahoo, tuna, swordfish and marlin. Large pelagic fish are typically widespread, found mainly in offshore waters (occasionally on the shelf) and often travel extensively.

In the EMBA, fish diversity and abundance is typically correlated with habitat distribution, with complex habitats, such as coral and rocky reefs, hosting more diverse and abundant assemblages. This is a typical pattern globally (Gratwicke and Speight 2005). Notable habitats hosting diverse fish assemblages include Ningaloo Reef (Stevens et al., 2009), Barrow and Montebello Islands (de Lestang and Jankowski 2015), Rowley Shoals (Bryce 2009), Glomar Shoals and Rankin Bank (Australian Institute of Marine Science (AIMS), 2014).

The Continental Slope Demersal Fish Communities KEF overlaps the Operational Areas and has been identified as one of the most diverse slope assemblages in Australian waters (see **Section 4.6.7.1**). Diversity of demersal fish assemblages on the continental slope between North West Cape and the Montebello Trough is among the highest in Australia (>500 species of which up to 76 are endemic), with the North West Cape region cited as a transition between tropical and temperate demersal and continental slope fish assemblages (Last et al., 2005). Fish assemblage species richness in the region has been shown to decrease with depth and be positively correlated with habitat complexity (Last et al., 2005).

The Enfield Canyon survey investigated three different sections of the canyon, ranging from the head of the canyon at the edge of the continental shelf (365–560 m water depth), an upper portion of the canyon (560–690 m water depth) and a lower portion of the canyon (800–870 m water depth). Abundance and diversity of fishes within each of the canyon sections surveyed was greater than the adjacent non-canyon habitats, although no differences between the three surveyed sections of the canyon were found. As such, the habitat within the surveyed portions canyon appears to host a distinct fish assemblage. Note the surveyed portions of the canyons did not appear to differ significantly physically on a fine scale than the adjacent non-canyon habitat (i.e. relatively flat, unconsolidated sediments characterised by silt and sand-sized fractions) (BMT Oceanica, 2016).

The survey observed 80 species from 41 families, which is consistent with data from the region more broadly (BMT Oceanica, 2016; Last et al., 2005). Ichthyofauna observed during the survey was characterised by macrourid, berycid, morid, liparid, halosaurid and congrid species, which is consistent with other observations of continental slope fish assemblages in the region (BMT Oceanica, 2016; Last et al., 2005). This slightly differed from the assemblages observed in the Greater Enfield area which also observed sternoptychid, oreosomatid and nettastomatid fishes (Heyward et al., 2001a; Heyward and Rees, 2001). Given the high diversity and low abundance that characterised fish assemblages in the upper continental slope, these differences are expected to be the result of relatively low sampling effort rather than actual differences between the assemblages observed, given the similar habitat in surveyed areas. Note the families observed during surveys in the vicinity of the Operational Areas are widely distributed in continental slope habitats, both in Australia and other ocean basins (Last et al., 2005), likely due to widespread nature of such continental slope habitats and lack of barriers to dispersal.

Surveys undertaken by Woodside in 2020 at the proposed IAR location found fish populations are relatively sparse, and comprise species with low recreational or commercial value.

Filter Feeders

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). Sessile filter feeders generally live in areas that have strong currents and hard substratum (CALM, 2005) and are closely associated with substrate type, with areas of hard substrate typically supporting more diverse epibenthic communities (Heyward et al., 2001b).

Several surveys of benthic filter feeder communities in and around the Operational Areas have been undertaken (BMT Oceanica, 2016; Heyward et al., 2001a; Heyward and Rees, 2001). Few areas of hard substrate were noted during the most recent survey of the Enfield Canyon and Operational Area 1, with the seabed at the location of the proposed development infrastructure characterised by low topographic complexity with silty clay/sand sediments. Isolated areas of hard substrate noted during the initial geophysical surveys were subsequently sampled during the recent survey, and found to be characterised by featureless isolated boulders with no different biota observed compared to the other surveyed areas of the canyon (BMT Oceanica, 2016).

Benthic filter feeding assemblages observed within the Enfield Canyon were consistent with those noted during previous surveys in the region (e.g. Heyward et al., 2001a; Heyward and Rees, 2001). Filter feeders observed during the survey consisted primarily of mobile invertebrates such as cnidarians, echinoderms and sponges, with no obvious differences between assemblages within and beyond the canyon (BMT Oceanica, 2016).

Woodside also conducted a benthic habitat survey of the proposed IAR location in 2020. The survey found benthic habitats almost entirely comprise bare silty sand, with epibiota (solitary cnidarians, one hermit crab specimen) occurring in densities less than 1% from ROV transect data.

As described in **Section 4.3.4**, five habitat types have been identified for the northern portion of the Ningaloo Marine Park adjacent to the proposed IAR location. Substrates are predominantly (89%) soft substrata ranging from silty to sand and shell dominated. Macrobiota were rare or occurred at low abundances on these substrata, although crinoids were relatively common in sandy areas with a significant shell component (Babcock et al., 2018). Areas characterised by the presence of gravel or boulders, or by reef substrata, were a relatively small proportion of the total area (11%) but carried much more abundant and larger biota dominated by filter feeders (sponges, gorgonians and bryozoans). These areas are likely to represent significant habitat for demersal fish (Babcock et al., 2018). The closest areas of gravel and boulders to the proposed IAR location are about 2.2 km away, to the south-east.

Within the EMBA, the NWMR has been identified as a sponge diversity hotspot with a high variety of areas of potentially high and unique sponge biodiversity, particularly in the Commonwealth waters of Ningaloo Marine Park (CALM, 2005; Rees et al., 2004). Filter feeder communities in the region are primarily located in the deeper waters of the Ningaloo Reef system as well as the Muiron Islands, Rowley Shoals and nearshore waters of the Pilbara Islands.

Other Benthic Communities

Benthic habitats of the continental slope in the Northwest Province bioregion comprise predominantly bare, unconsolidated, muddy substrate types (Baker et al., 2008). Such habitat is broadly represented throughout the Northwest Province, and typically supports sparse assemblages of filter and deposit-feeding epibenthic fauna (Woodside Energy Limited, 2005). Environmental surveys in the area have shown a diverse, but broadly representative infaunal community, dominated by polychaete worms and crustaceans (RPS Environment and Planning, 2012a). Offshore, deeper water epifauna (for example mobile benthic taxa, such as echinoderms or sessile taxa such as sponges) are typically sparse and patchy in distribution. Offshore seabed surveys across the NWS have detected a general reduction in epibenthic coverage as depth increases (Fulton et al., 2006). The Commonwealth Scientific and Industrial Research Organisation (CSIRO) survey revealed that large epifauna (greater than 25 cm such as sponges) are rare beyond the 100 m isobath (Fulton et al., 2006).

Despite the lack of significant areas of hard substrate within the Operational Areas, some deep-water filter feeding communities are still expected to be present in the silty clay/sand sediments, including deposit feeding epifauna (e.g. holothurians) and infauna (e.g. polychaetes). A benthic community assessment has been carried out for WA-28-L, and included ROV surveys near Operational Area 1 by AIMS. The surveys revealed four main invertebrate groups of deepwater benthos including crustaceans, sponges, echinoderms and cnidarians (octocorals) (Heyward and Rees, 2001).

The results of the North West Cape Continental Shelf and Slope survey (Heyward et al., 2001b) indicated that the distribution of biota in the vicinity of the Operational Areas was patchy, with epibenthic fauna demonstrating heterogeneity in abundance and diversity both within and between depths. These differences were more marked on the upper slope and continental shelf stations (50–450 m depth) and appeared to be related, with variation in seabed sediments. A more heterogeneous mix of both soft sediment areas and consolidated areas were present between 50–450 m depths, with either a veneer of fine soft sediment or occasionally as outcropping rock.

Similarly, recent observations of epifauna in the Enfield canyon indicated the density of deposit-feeding fauna was low and sparsely distributed throughout the surveyed area (BMT Oceanica, 2016), which is consistent with results from other investigations in the region (Heyward et al., 2001a; Heyward and Rees, 2001). Deposit-feeding fauna (e.g. holothurians and echinoids) were relatively more abundant in the continental slope portion of the canyon than the head of the canyon (on the continental shelf break). The relative increase of deposit feeding fauna in this part of the canyon may be indicative of increased food availability, potentially related to increased deposition through reduced water movement (BMT Oceanica, 2016). This was consistent with casual observation of stronger currents at the canyon head during the Enfield Canyon systems survey (BMT Oceanica, 2016, **Section 4.4.2.5**). Bioturbation was observed within the Enfield Canyon, indicating the presence of burrowing epifauna and infauna (BMT Oceanica, 2016).

4.4.2.5 Enfield Canyon Environmental Survey

A targeted survey of the Enfield Canyon system, as well as the surrounding seabed, was undertaken in 2015 (BMT Oceanica, 2016). The primary objective of the survey was to investigate physical and biological characteristics of the deepwater geomorphological seabed features within Operational Area 1, and adjacent representative canyon features.

The following survey activities were undertaken through the deployment of a work class ROV fitted with ancillary survey equipment:

- habitat mapping of key physical and biological characteristics as derived from the physical and biological attributes
- description and high level classification of physical attributes (seabed habitat, sediment composition and physico-chemical characteristics)
- description of the biological attributes (benthic community composition/structure and description of benthic biota; epifauna and infauna)
- description of fish populations
- observations/evidence of environmental pressures such as natural or anthropogenic perturbations (seabed disturbance, fishing gear abandonment etc.).

The areas of interest were chosen to provide comparisons of the canyon environment within the development area (Area A) and non-development areas (Areas B and C) (See **Figure 4-9**).

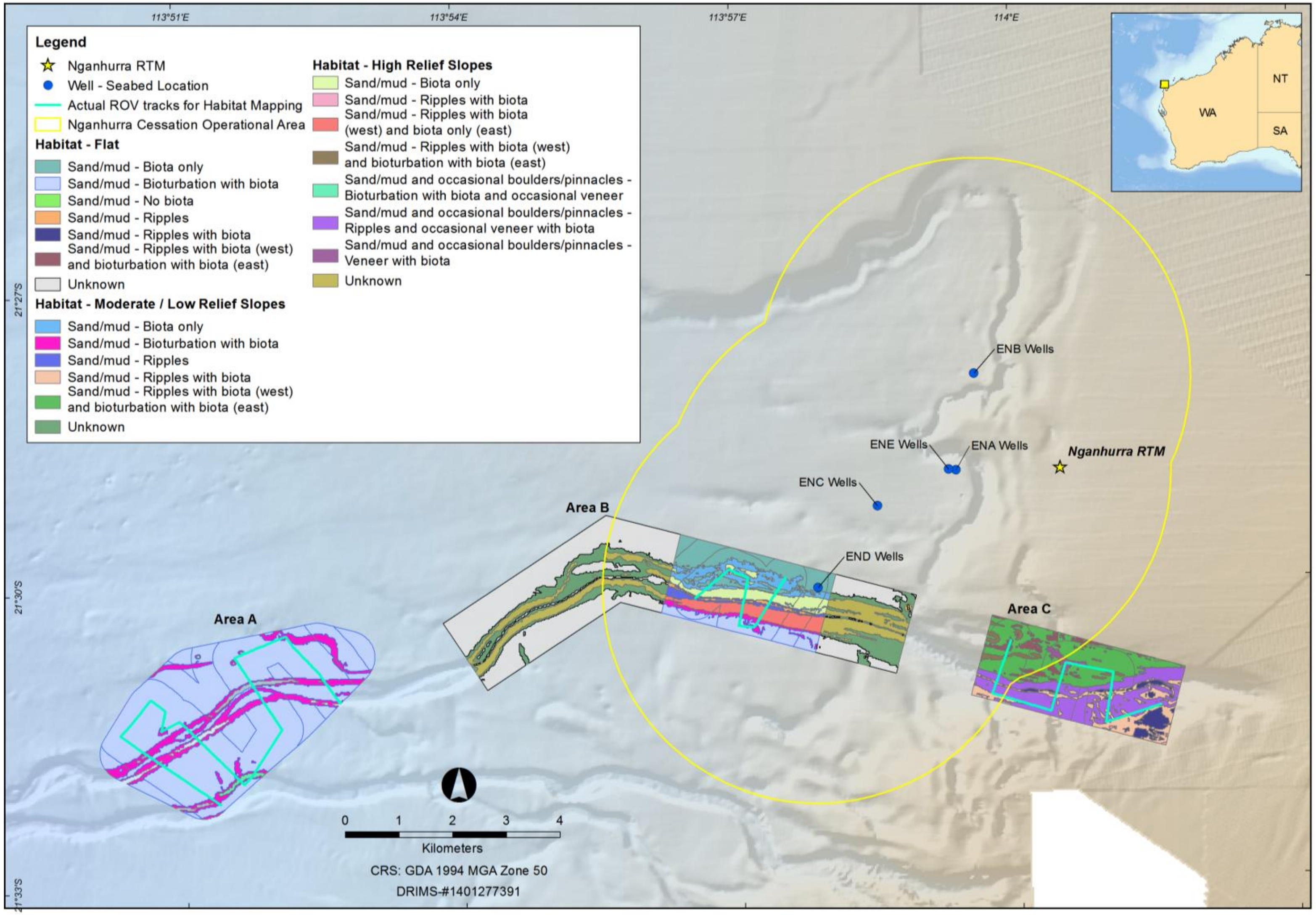


Figure 4-9: Benthic habitat map of the Enfield Region showing Area B and Area C within the NGA cessation operational area 1

(BMT Oceanica, 2016)

Area A was the deepest survey location and encompassed a portion of the North and South Enfield Canyons. Area B1 was a representative portion of North Enfield Canyon and Area B2 incorporated the head of the North Enfield Canyon. Area C was proposed to be sampled but could not be completed due to weather constraints. A summary of the type and nature of data collected for each of the completed tasks is presented in **Table 4-2**.

Table 4-2: Type and nature of survey data collected

Area	Tasks	Details
Area A	Transect 1 – Habitat and fish video	• Depth range: 800–870 m • Transect length: 10.8 km • Time: 13.5 hours • ROV speed (mean): 0.4–0.5 knots
Area B1	Transect 2 – Habitat and fish video	• Depth range: 560–690 m • Transect length: 3.5 km • Time: 4 hours 10 minutes • ROV speed (mean): 0.4–0.5 knots
Area B2	Transect 3 – Habitat and fish video	• Depth range: 365–560 m • Transect length: 6.5 km • Time: 7 hours 34 minutes • ROV speed (mean): 0.4–0.5 knots
Area A	Six sites – sediment collection	• Collected ten push cores from site A1 only • Duration: about 3.5 hours • Two ROV deployments (with five push cores per deployment)

4.4.3 Species

4.4.3.1 Protected Species

The EPBC Act PMST has been used to identify listed species that may occur within and adjacent to the Operational Areas and EMBA; this informs the assessment of planned events as well as unplanned events in **Section 6.6** and **Section 6.6.2**. EPBC Act PMST reports were generated to identify MNES within the Operational Areas and the EMBA for the worst-case hydrocarbon spill scenarios considered in this EP, including areas of potential shoreline accumulation. 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. A number of MNES identified by the EPBC Act PMST reports were not considered to be credibly impacted (e.g. terrestrial species), which have been excluded from further consideration (**Appendix C**).

Information regarding species within the EMBA is included within this section and **Section 4.6**, and was used to inform the assessment of both planned and unplanned events in **Section 6.6** and **Section 6.6.2**.

A total of 84 EPBC Act listed species considered MNES (41 and 73 listed as threatened or migratory, respectively) were identified as potentially occurring within the EMBA, of which 33 were identified as potentially occurring within the Operational Areas (**Table 4-3**). The full list of marine species identified is provided in the EPBC Act PMST Report (**Appendix C**). Two Conservation Dependent species under the EPBC Act were found within the Operational Areas and EMBA, but are not currently included in the EPBC Protected Matters search. These species, the southern bluefin tuna, and scalloped hammerhead, are listed on the Species Profile and Threats Database (DoEE, 2019) and are described in **Section 4.4.3.4**.

Table 4-3: Threatened and migratory marine species listed under the EPBC Act potentially occurring with the Operational Areas and EMBA

Species	Common name	Threatened status	Migratory status	Operational Areas / EMBA		
				Operational Area 1	Operational Area 2	EMBA
Marine Mammals						
Balaenoptera borealis	Sei Whale	Vulnerable	Migratory	Y	Y	Y
Balaenoptera musculus	Blue Whale	Endangered	Migratory	Y	Y	Y
Balaenoptera physalus	Fin Whale	Vulnerable	Migratory	Y	Y	Y
Megaptera novaeangliae	Humpback Whale	Vulnerable	Migratory	Y	Y	Y
Balaenoptera edeni	Bryde's Whale	N/A	Migratory	Y	Y	Y
Orcinus orca	Killer Whale	N/A	Migratory	Y	Y	Y
Physeter macrocephalus	Sperm Whale	N/A	Migratory	Y	Y	Y
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	N/A	Migratory	Y	Y	Y
Eubalaena australis	Southern Right Whale	Endangered	Migratory	Y	Y	Y
Balaenoptera bonaerensis	Antarctic Minke Whale	N/A	Migratory	Y	N/A	Y
Sousa chinensis	Indo-Pacific Humpback Dolphin	N/A	Migratory	N/A	N/A	Y
Neophoca cinerea	Australian Sea-lion, Australian Sea Lion	Vulnerable	N/A	N/A	N/A	Y
Dugong dugon	Dugong	N/A	Migratory	N/A	N/A	Y
Marine Reptiles						
Caretta caretta	Loggerhead turtle	Endangered	Migratory	Y	Y	Y
Chelonia mydas	Green turtle	Vulnerable	Migratory	Y	Y	Y
Dermochelys coriacea	Leatherback turtle, leathery turtle, luth	Endangered	Migratory	Y	Y	Y

Species	Common name	Threatened status	Migratory status	Operational Areas / EMBA		
				Operational Area 1	Operational Area 2	EMBA
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory	Y	Y	Y
Natator depressus	Flatback turtle	Vulnerable	Migratory	Y	Y	Y
Aipysurus apraefrontalis	Short-nosed seasnake	Critically endangered	N/A	N/A	Y	Y
Fishes and Elasmobranchs						
Carcharodon carcharias	Great White Shark	Vulnerable	Migratory	Y	Y	Y
Anoxypristis cuspidata	Narrow Sawfish	N/A	Migratory	Y	Y	Y
Isurus oxyrinchus	Shortfin Mako	N/A	Migratory	Y	Y	Y
Isurus paucus	Longfin Mako	N/A	Migratory	Y	Y	Y
Manta birostris	Giant Manta Ray	N/A	Migratory	Y	Y	Y
Carcharias taurus	Grey Nurse Shark (west coast population)	Vulnerable	N/A	N/A	Y	Y
Pristis zijsron	Green Sawfish	Vulnerable	Migratory	N/A	Y	Y
Rhincodon typus	Whale Shark[4]	Vulnerable	Migratory	Y	Y	Y
Manta alfredi	Reef Manta Ray	N/A	Migratory	N/A	Y	Y
Pristis clavata	Dwarf Sawfish	Vulnerable	Migratory	N/A	Y	Y
Lamna nasus	Porbeagle, Mackerel Shark	N/A	Migratory	N/A	N/A	Y
Thunnus maccoyii	Southern Bluefin Tuna	Conservation Dependent	Migratory	Y	Y	Y
Sphyrna lewini	Scalloped Hammerhead	Conservation Dependent	N/A	Y	Y	Y

[4] Not identified in the PMST report, however tracking data shows the species within the Operational Area.

Species	Common name	Threatened status	Migratory status	Operational Areas / EMBA		
				Operational Area 1	Operational Area 2	EMBA
Birds						
Calidris canutus	Red Knot, Knot	Endangered	Migratory	Y	Y	Y
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Critically Endangered	Migratory	Y	Y	Y
Anous stolidus	Common Noddy	N/A	Migratory	Y	Y	Y
Fregata ariel	Lesser Frigatebird	N/A	Migratory	Y	Y	Y
Actitis hypoleucos	Common Sandpiper	N/A	Migratory	Y	Y	Y
Calidris acuminata	Sharp-tailed Sandpiper	N/A	Migratory	Y	Y	Y
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory	Y	Y	Y
Pandion haliaetus	Osprey	N/A	Migratory	Y	Y	Y
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory	Y	Y	Y
Macronectes giganteus	Southern Giant-Petrel	Endangered	Migratory	Y	Y	Y
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	N/A	Y	Y	Y
Sternula nereis	Australian Fairy Tern	Vulnerable	N/A	Y	Y	Y
Ardenna carneipes	Flesh-footed Shearwater	N/A	Migratory	Y	Y	Y
Anous tenuirostris melanops	Australian Lesser Noddy	Vulnerable	N/A	N/A	N/A	Y
Calonectris leucomelas	Streaked Shearwater	N/A	Migratory	N/A	Y	Y
Fregata minor	Great Frigatebird	N/A	Migratory	N/A	N/A	Y
Limosa lapponica baueri	Bar-tailed Godwit	Vulnerable	Migratory	N/A	N/A	Y
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically Endangered	Migratory	N/A	N/A	Y
Macronectes halli	Northern Giant Petrel	Vulnerable	Migratory	N/A	N/A	Y
Papasula abbotti	Abbott's Booby	Endangered	N/A	N/A	N/A	Y

Species	Common name	Threatened status	Migratory status	Operational Areas / EMBA		
				Operational Area 1	Operational Area 2	EMBA
Rostratula australis	Australian Painted-snipe	Endangered	N/A	N/A	N/A	Y
Diomedea amsterdamensis	Amsterdam Albatross	Endangered	Migratory	N/A	N/A	Y
Diomedea epomophora	Southern Royal Albatross	Vulnerable	Migratory	N/A	N/A	Y
Diomedea exulans	Wandering Albatross	Vulnerable	Migratory	N/A	N/A	Y
Diomedea sanfordi	Northern Royal Albatross	Endangered	Migratory	N/A	N/A	Y
Thalassarche carteri	Indian Yellow-nosed Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche cauta	Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche cauta steadi	White-capped Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche impavida	Campbell Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche melanophris	Black-browed Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche cauta	Tasmanian Shy Albatross	Vulnerable	Migratory	N/A	N/A	Y
Apus pacificus	Fork-tailed Swift	N/A	Migratory	N/A	N/A	Y
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory	Y[1]	Y[1]	Y
Hydroprogne caspia	Caspian Tern	N/A	Migratory	N/A	N/A	Y
Onychoprion anaethetus	Bridled Tern	N/A	Migratory	N/A	N/A	Y
Sterna dougallii	Roseate Tern	N/A	Migratory	N/A	N/A	Y
Charadrius veredus	Oriental Plover	N/A	Migratory	N/A	N/A	Y
Glareola maldivarum	Oriental Pratincole	N/A	Migratory	N/A	N/A	Y
Thalasseus bergii	Crested Tern	N/A	Migratory	N/A	N/A	Y
Tringa nebularia	Common Greenshank	N/A	Migratory	N/A	N/A	Y
Limosa	Black-tailed Godwit	N/A	Migratory	N/A	N/A	Y

Species	Common name	Threatened status	Migratory status	Operational Areas / EMBA		
				Operational Area 1	Operational Area 2	EMBA
Pluvialis squatarola	Grey Plover	N/A	Migratory	N/A	N/A	Y
Numenius phaeopus	Whimbrel	N/A	Migratory	N/A	N/A	Y
Sternula albifrons	Little Tern	N/A	Migratory	N/A	N/A	Y
Phaethon lepturus	White-tailed Tropicbird	N/A	Migratory	N/A	N/A	Y
Phaethon rubricauda	Red-tailed Tropicbird	N/A	Migratory	N/A	N/A	Y
Arenaria interpres	Ruddy Turnstone	N/A	Migratory	N/A	N/A	Y
Calidris alba	Sanderling	N/A	Migratory	N/A	N/A	Y
Calidris ruficollis	Red-necked Stint	N/A	Migratory	N/A	N/A	Y
Tringa brevipes	Grey-tailed Tattler	N/A	Migratory	N/A	N/A	Y
Tringa glareola	Wood Sandpiper	N/A	Migratory	N/A	N/A	Y
Xenus cinereus	Terek Sandpiper	N/A	Migratory	N/A	N/A	Y

[1] *Although this species was not identified in PMST reports for the Operational Areas, given it has a BIA overlapping both Operational Area 1 and 2, it has been included as it occurs within the two areas.*

EPBC Act Part 13 Statutory Instruments

Conservation advice and recovery plans for listed threatened species, threat abatement plans for key threatening processes, and wildlife conservation plans for listed migratory/marine species and cetaceans, are developed and implemented under Part 13 of the EPBC Act.

Recovery plans are enacted under the EPBC Act and remain in force until the species is removed from the threatened list. Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to facilitate the conservation of a listed species or ecological community.

Table 4-4 outlines the Part 13 statutory instruments relevant to those species identified as potentially occurring within or using habitat in the Operational Areas and EMBA areas from the EPBC Act Protected Matters search (**Appendix C**). A screening process was conducted to identify which of these species, and associated Part 13 statutory instruments, are relevant in the context of the assessment of impacts and risks associated with the Petroleum Activities Program. These criteria were used for this screening:

- Overlap between Operational Areas and EMBAs with habitat critical for the survival of marine turtles, and with BIAs 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 Operational Areas.
- Temporal overlap between the timing of the Petroleum Activities Program and peak periods for key behaviours (e.g. breeding, nesting, calving, resting, foraging, migration).
- An aspect associated with the activity has been identified as a key threat to the species in a Part 13 statutory instrument (e.g. anthropogenic noise, light emissions, marine debris, etc.).

For those Part 13 statutory instruments identified as relevant to the activity, the objectives, action areas and actions were considered during the assessment of impacts and risks (**Section 6**).

Table 4-4: Part 13 statutory instruments for EPBC Act listed species identified from PMST searches

Species	EPBC Act Part 13 statutory instrument	Considered during impact/risk assessment	Relevant EP section
All vertebrate fauna			
All vertebrate fauna	Threat abatement plan for the impacts of marine debris on vertebrate marine life (Commonwealth of Australia, 2018).	Y	6.7.2.1
Cetaceans (Whales and Dolphins)			
Sei whale	Conservation Advice for *Balaenoptera borealis* (Sei whale) (Threatened Species Scientific Committee 2015a)	N	N/A
Blue whale	Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015–2025 (Commonwealth of Australia 2015a)	Y	6.6.1.6, 6.6.2.4, 6.7.1.7, 6.7.2.5
Fin whale	Approved Conservation Advice for *Balaenoptera physalus* (Fin whale) (Threatened Species Scientific Committee 2015b)	N	N/A
Southern right whale	Conservation management plan for the southern right whale: a recovery plan under the EPBC Act 1999 2011–2021 (Commonwealth of Australia 2012b)	N	N/A
Humpback whale	Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee 2015a)	Y	6.6.1.6, 6.6.2.4, 6.7.1.7, 6.7.2.5
Australian sea lion	Recovery plan for the Australian sea lion (*Neophoca cinerea*) (Commonwealth of Australia 2013)	Y	6.6.2.2, 0, 6.6.2.4, 6.7.2.2
Reptiles			
All marine turtle species (loggerhead, green, leatherback, hawksbill, flatback, olive ridley)	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017)	Y	6.6.1.6, 6.6.2.4, 6.7.1.7, 6.7.2.5, 6.6.2.2, 0, 6.6.2.4, 6.7.2.2
Leatherback turtle	Approved conservation advice for *Dermochelys coriacea* (Leatherback Turtle) (Threatened Species Scientific Committee 2008a)	Y	

Species	EPBC Act Part 13 statutory instrument	Considered during impact/risk assessment	Relevant EP section
Short-nosed seasnake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (Department of the Environment 2013a)	Y	6.6.2.2, 0, 6.6.2.4, 6.7.2.1, 6.7.2.2
Sharks and Rays			
White shark	Recovery plan for the white shark (*Carcharodon carcharias*) (Commonwealth of Australia 2013c)	N	N/A
All sawfish (green, dwarf, narrow)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b).	Y	6.6.2.2, 0, 6.6.2.4, 6.7.2.1, 6.7.2.2
Dwarf sawfish	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (Threatened Species Scientific Committee 2009).	Y	
Green sawfish	Approved conservation advice for green sawfish (Threatened Species Scientific Committee 2008b)	Y	
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (Commonwealth of Australia 2014)	Y	6.6.2.2, 0, 6.6.2.4, 6.7.2.1, 6.7.2.2
Whale shark	Approved Conservation advice *Rhincodon typus* (whale shark) (Threatened Species Scientific Committee 2015b)	Y	6.6.2.8, 6.7.2.5
Birds			
Migratory shorebird species	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c).	Y	6.6.1.5, 6.6.2.2, 0, 6.6.2.4, 6.6.2.7, 6.6.2.8, 6.7.1.6, 6.7.2.1, 6.7.2.2, 6.7.2.4, 6.7.2.5
Red knot, knot	Approved Conservation Advice for *Calidris canutus* (red knot) (Threatened Species Scientific Committee, 2016c)	Y	
Eastern curlew, far eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (eastern curlew) (Threatened Species Scientific Committee, 2015d)	Y	
Australian lesser noddy	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy. (Threatened Species Scientific Committee, 2015e)	Y	
Abbott's booby	Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee, 2015f)	Y	
Australian painted snipe	Approved conservation advice on *Rostratula australis* (Australian Painted Snipe) (Threatened Species Scientific Committee 2013)	Y	

Species	EPBC Act Part 13 statutory instrument	Considered during impact/risk assessment	Relevant EP section
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (Threatened Species Scientific Committee 2015c)	Y	
All petrels and albatrosses (southern giant-petrel, soft-plumaged petrel, northern giant petrel, indian yellow-nosed albatross, tasmanian shy albatross, white-capped albatross, campbell albatross, black-browed albatross)	National recovery plan for threatened albatrosses and giant petrels 2011–2016 (Commonwealth of Australia 2011)	Y	
Australian fairy tern	Conservation advice for *Sterna nereis* (Australian Fairy tern) (Threatened Species Scientific Committee 2011a)	Y	
Bar-tailed godwit (*baueri*)	Conservation advice *Limosa lapponica baueri* bar-tailed godwit (western Alaskan) (Threatened Species Scientific Committee 2016a)	Y	
Northern Siberian bar-tailed godwit	Conservation advice *Limosa lapponica menzbieri* bar-tailed godwit (northern Siberian) (Threatened Species Scientific Committee 2016b)	Y	

Habitat Critical to the Survival of a Species

In accordance with the EPBC Act Significant Impact Guidelines 1.1 – Matters of National Environmental Significance, an action is deemed to have a significant impact if there is a real chance or possibility that it will adversely affect 'habitat critical to the survival of a species'. Habitat critical to the survival of a species for marine turtles has identified nesting and internesting habitat for each genetic stock based on a set criterion outlined in the Recovery Plan for Marine Turtles in Australia 2017–2027 (Commonwealth of Australia, 2017).

Operational Area 2 overlaps habitat critical to the survival of a species for green, flatback and loggerhead turtles; however, there is no overlap with Operational Area 1 (as shown in **Table 4-5**).

Table 4-5: Nesting and internesting areas identified as habitat critical to the survival of marine turtles for each stock that overlap the Operational Areas and EMBA.

Species	Nesting Location	Overlap with Operational Areas	Major nesting area	Inter-nesting buffer	Nesting period	Hatching period
Green turtle	Barrow Island	N/A	✓	20 km	Nov–Mar	Jan–May (peak: Feb–Mar)
	Montebello Islands (all with sandy beaches)	N/A	✓	20 km	Nov–Mar	Jan–May (peak: Feb–Mar)
	Serrurier Island	N/A		20 km	Nov–Mar	Jan–May (peak: Feb–Mar)
	Thevenard Island	N/A		20 km	Nov–Mar	Jan–May (peak: Feb–Mar)
	North West Cape	Overlaps Operational Area 2	✓	20 km	Nov–Mar	Jan–May (peak: Feb–Mar)
	Ningaloo Coast	Overlaps Operational Area 2		20 km	Nov–Mar	Jan–May (peak: Feb–Mar)
Loggerhead turtle	Dirk Hartog Island	N/A	✓	20 km	Nov–May	Jan–May
	Muiron Islands	N/A	✓	20 km	Nov–May	Jan–May
	Gnaraloo Bay	N/A	✓	20 km	Nov–May	Jan–May
	Ningaloo Coast	Overlaps Operational Area 2		20 km	Nov–May	Jan–May
Flatback turtle	Montebello Islands (all with sandy beaches)	N/A		60 km	Oct–Mar	Feb–Mar
	Barrow Island	N/A	✓	60 km	Oct–Mar	Feb–Mar
	coastal islands from Cape Preston to Locker Island	Overlaps Operational Area 2		60 km	Oct–Mar	Feb–Mar
Hawksbill turtle	Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island)	N/A	✓	20 km	Oct–Feb	all year (peak: Dec–Feb)
	Lowendal Islands (including Varanus	N/A		20 km	Oct–Feb	all year (peak: Dec–Feb)

Species	Nesting Location	Overlap with Operational Areas	Major nesting area	Inter-nesting buffer	Nesting period	Hatching period
	Island, Beacon Island and Bridled Island)					

Biologically Important Areas

A review of the National Conservation Values Atlas identified that the following biologically important areas (BIAs) overlap spatially with the Operational Areas:

Operational Areas 1 and 2:

- humpback whale migration (annual seasonal migration with their presence during peak periods in the Exmouth region between June–August (northbound migration) and August to October, following closer to the WA coastline (southbound migration))
- pygmy blue whale migration (annual seasonal migration with peak numbers passing Exmouth region towards Indonesia between April–August (northerly migration)) and their southerly return passing North West Cape (late November–December))
- foraging, breeding area for the wedge-tailed shearwater during its breeding season (August–April).

Operational Area 2:

- hawksbill turtle internesting BIA on Thevenard Island (peak season in spring and early summer)
- loggerhead internesting BIA on Ningaloo coast and Jurabi coast (November to May)
- flatback turtle internesting BIA on Ningaloo coast and Jurabi coast (October to March)
- green turtle internesting BIA along North West Cape (November to March).

The Marine bioregional plan for the North-west Marine Region (prepared under the *Environment Protection and Biodiversity Conservation Act 1999*) defines a BIA as a defined area of spatial aggregations of individuals of a species are known in the literature to demonstrate biologically important behaviour such as breeding, foraging, resting and migration. A number of BIAs occur within the EMBA, which are provided in **Table 4-6**. The BIA distance that is closest to the Operational Areas (Operational Area 1 or 2) has been measured. Additional information on BIAs is provided in the species-specific summaries throughout **Section 4.4.3**.

Table 4-6: BIAs within the Operational Area and in the EMBA

Species	BIA type	Distance of BIA from Operational Area (km)
Marine Mammals		
Humpback whale	Migration (Exmouth)	Overlaps Operational Areas
Pygmy blue whale	Migration (Exmouth, North West Cape)	Overlaps Operational Areas
Dugong	Multi-use (breeding/calving/foraging/nursing) (Exmouth Gulf and Ningaloo Reef)	10 (Operational Area 2)
Australian Sea lion	Foraging (Shark Bay[1], Abrolhos and adjacent coast)	728 (Operational Area 2)
Marine Reptiles		
Flatback turtle	Internesting (Thevenard Island[1], Montebello Islands, Dampier Archipelago)	Overlaps Operational Area 2
	Nesting (Thevenard Island [1], Barrow Island, Montebello Islands)	57 (Operational Area 2)

Species	BIA type	Distance of BIA from Operational Area (km)
Green turtle	Internesting (North West Cape[1], Muiron Islands, Montebello Islands, Barrow Island)	Overlaps Operational Area 2
	Nesting (Montebello Islands)	185
Hawksbill turtle	Internesting (Ningaloo coast and Jurabi coast[1], Thevenard Island, Barrow Island, Lowendal Islands, Montebello Islands, Varanus Island)	Overlaps Operational Area 2
	Nesting (Ningaloo coast and Jurabi coast[1], Thevenard Island, Barrow Island, Varanus Island, Lowendal Islands)	11 (Operational Area 2)
Loggerhead turtle	Internesting (Ningaloo coast and Jurabi coast[1], Muiron Islands, Gnaraloo Bay, Montebello Islands, Lowenthal Island, Dirk Hartog Island)	Overlaps Operational Area 2
	Nesting (Ningaloo coast and Jurabi coast[1], Muiron Islands, Gnaraloo Bay, Montebello Islands, Lowenthal Island, Dirk Hartog Island)	10 (Operational Area 2)
Sharks, Fish and Rays		
Whale Shark	Foraging (northward from Ningaloo along 200 m isobath)	7 (Operational Area 2)
	Foraging (Ningaloo Marine Park)	14 (Operational Area 2)
Great white shark	Foraging (Abrolhos)	736 (Operational Area 1)
Birds		
Wedge-tailed Shearwater	Foraging, breeding (Exmouth, Barrow Island, Dampier Archipelago, Shark Bay, Ningaloo)	Overlaps Operational Areas
Australian Fairy Tern	Breeding, foraging (North West Cape[1], Shark Bay, Abrolhos, Montebello Islands, Barrow Island)	15 (Operational Area 2)
Roseate Tern	Breeding (Ningaloo[1], Shark Bay, Dirk Hartog Island, Abrolhos, Thevenard Island, Barrow Island)	74 (Operational Area 2)
Bridled Tern	Foraging (south along the WA coast from Shark Bay)	465 (Operational Area 2)
Sooty Tern	Foraging (Abrolhos Islands and wider oceanic waters)	486 (Operational Area 2)
White-faced Storm petrel[2]	Foraging (south from the Abrolhos Islands)	611 (Operational Area 2)
Little Shearwater[2]	Foraging (south from the Abrolhos Islands)	624 (Operational Area 2)
Common noddy	Foraging (Houtman Abrolhos Islands)	712 (Operational Area 2)
Pacific Gull[2]	Foraging (Abrolhos)	670 (Operational Area 2)
Australian Lesser Noddy	Foraging (Houtman Abrolhos Islands)	736 (Operational Area 2)
Soft-plumaged Petrel	Foraging (south from the Abrolhos Islands)	833 (Operational Area 2)

[1] Denotes the closest BIA to the Operational Areas where multiple BIAs of the same type overlap the EMBA. Where relevant, distances have been provided for the BIAs closest to the Operational Area (1 or 2) only.

[2] Species is not listed as threatened or migratory under EPBC Act (i.e. listed as least concern).

Seasonal Sensitivities of Protected Species

Periods of the year coinciding with key environmental sensitivities for the Operational Areas and the EMBA, including EPBC Act listed threatened and/or migratory species, are presented in **Table 4-7**. These relate to breeding, foraging or migration of the indicated fauna.

Table 4-7: Key environmental sensitivities and timings for migratory fauna identified within the Operational Areas and/or EMBA

Species	January	February	March	April	May	June	July	August	September	October	November	December
Blue whale – northern migration (Exmouth, Montebello, Scott Reef)[1]												
Blue whale – southern migration (Exmouth, Montebello, Scott Reef)[2]												
Humpback whale – northern migration (Jurien Bay to Montebello)[3]												
Humpback whale – southern migration (Jurien Bay to Montebello)[4]												
Green turtle – various nesting areas[5]												
Flatback turtle – various nesting areas[5]												
Loggerhead turtle – various nesting areas[5]												
Hawksbill turtles – various nesting areas[6]												
Manta rays – presence/aggregation/breeding (Ningaloo)[7]												
Whale shark* – foraging/aggregation near Ningaloo[8]												
Caspian tern – breeding (Ningaloo)[9]												
Crested tern – breeding (Ningaloo)[9]												
Australian Fairy tern – breeding (Ningaloo)[9]												
Osprey – breeding (Ningaloo)[9]												
Roseate tern – breeding (Ningaloo)[9]												

Species	January	February	March	April	May	June	July	August	September	October	November	December
Wedge-tailed shearwater – various breeding sites[9]												

	Species likely to be present in the region
	Peak period. Presence of animals reliable and predictable each year

References for species seasonal sensitivities:

1. *DSEWPaC, 2012a; McCauley and Jenner, 2010; McCauley, 2011*
2. *DSEWPaC, 2012a; McCauley and Jenner, 2010*
3. *CALM, 2005; Environment Australia, 2002; Jenner et al., 2001a; McCauley and Jenner, 2001*
4. *McCauley and Jenner, 2001*
5. *Commonwealth of Australia, 2017; Chevron, 2015; CALM, 2005; DSEWPaC, 2012a*
6. *Commonwealth of Australia, 2017; Chevron, 2015*
7. *Environment Australia, 2002*
8. *CALM, 2005; Environment Australia, 2002*
9. *DSEWPaC, 2012c; Environment Australia, 2002*

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

4.4.3.2 Marine Mammals

Cetaceans – Whales

Antarctic Minke Whale

The Antarctic minke whale is distributed worldwide and has been recorded off all Australian states, feeding in cold waters and migrating to warmer waters to breed. It is thought that the Antarctic minke whale migrates up the WA coast up to Port Hedland to feed and possibly breed (Bannister et al., 1996); however, detailed information on timing and location of migrations and breeding grounds is not well known. Given the wide distribution of Antarctic minke whale, the Operational Areas and the EMBA are unlikely to represent an important habitat for this species. Their presence in the Operational Areas is likely to be a remote occurrence and limited to a few individuals infrequently transiting the area. In the EMBA, the Antarctic minke whale may be seasonally present during winter months in low numbers.

Blue Whale

There are two recognised subspecies 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) (Commonwealth of Australia 2015a). On this basis, nearly all blue whales sighted in the NWMR are likely to be pygmy blue whales.

Pygmy blue whales are known to undertake seasonal migration between temperate/sub-Antarctic and tropical waters (Double et al., 2014). In the NWMR, pygmy blue whales migrate along the 500 m to 1000 m depth contour on the edge of the slope. They are likely to carry out opportunistic feeding on ephemeral krill aggregations (DEWHA, 2008). Sea noise loggers and satellite tracking at various locations along the Western Australian coast have detected an annual northbound migration past Exmouth and the Montebello Islands between April and August, peaking in May to June, and southbound migration from October to the end of January, peaking in late November to early December (Double et al., 2014; McCauley and Duncan, 2011; McCauley and Jenner, 2010).

Satellite tagging (2009–2012) of pygmy blue whales off the Perth Canyon confirmed the general distribution of pygmy blue whales was offshore in water depths over 200 m and commonly over 1000 m (Double et al., 2012b) (**Figure 4-10**). Data showed that whales tagged during March and April migrated northwards post tag deployment. The tagged whales travelled relatively near to the Australian coastline (100.0 ± 1.7 km) until reaching North West Cape after which they travelled offshore (238.0 ± 13.9 km). Whales reached the northern terminus of their migration and potential breeding grounds in Indonesian waters by June (Double et al., 2014).

The 2015 Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015a) has delineated the distribution area of blue whales in Australian waters and identified a number of BIAs for blue whales within WA waters (migratory corridor and foraging areas). The plan also documents that the pygmy blue whale which feed off the Perth Canyon and the Bonney Upwelling (South Australia and Victoria) constitute the same population. The migration BIA off the coast of WA overlaps the Operational Areas and EMBA. A foraging BIA lies off the Ningaloo Coast (beyond the Operational Areas but within the EMBA), within which pygmy blue whales may feed (Double et al., 2014). The 2015 Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015a) describes this BIA as a possible foraging area, where evidence for feeding is based on limited direct observations or indirect evidence, such as prey occurring close to the whale or satellite tracks showing circling tracks. The migration BIA off the coast of WA overlaps the Operational Areas and EMBA.

In summary, pygmy blue whales are likely to occur within the Operational Areas and EMBA, particularly during their defined annual migrations. When individuals do occur within the Operational Areas and EMBA, it is likely there will be only one or a few individuals and their time in the area will be brief.

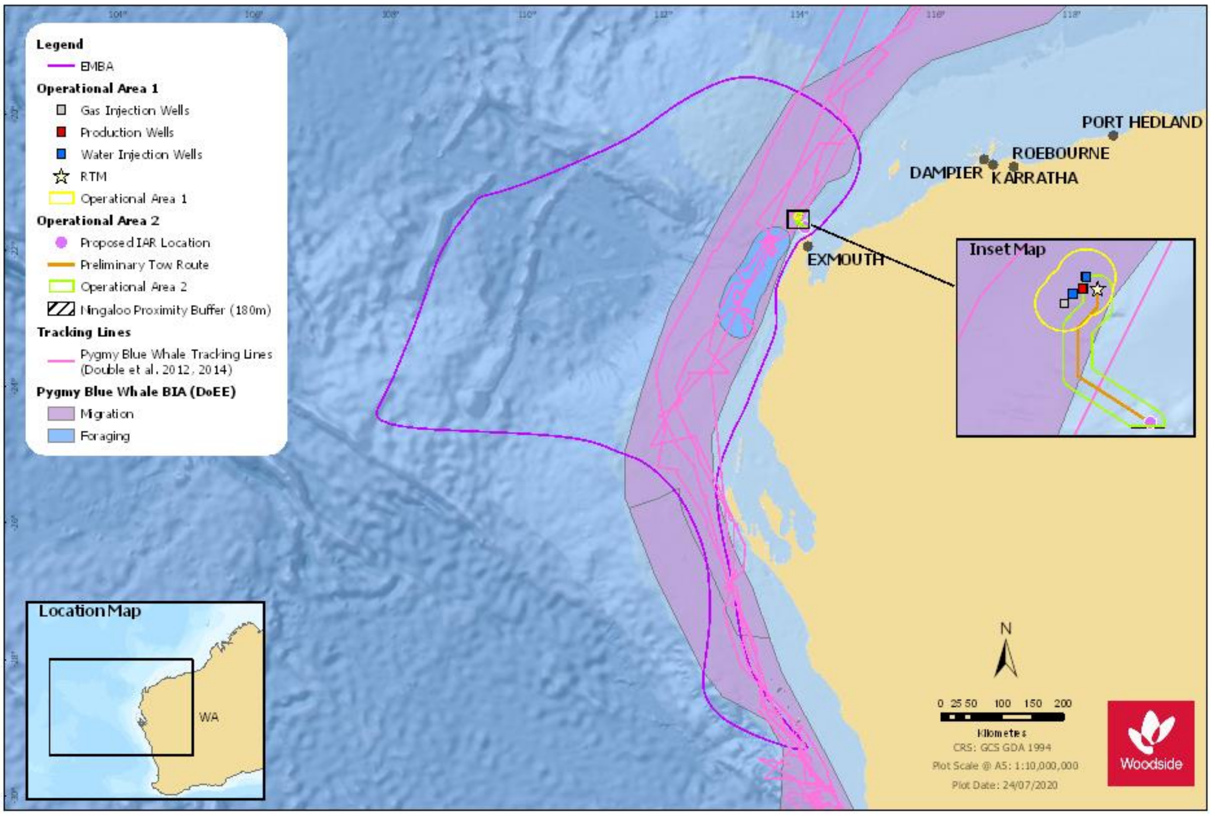


Figure 4-10: Pygmy blue whales satellite tracks and BIAs

(Double et al., 2012b, 2014)

Bryde's Whale

The Bryde's whale was identified as potentially occurring within the Operational Areas and EMBA. The Bryde's Whale occurs in tropical and temperate waters (Bannister et al., 1996). Bryde's whales occur in both oceanic and inshore waters, with the only key localities recognised in WA being in the Abrolhos Islands and north of Shark Bay (Bannister et al., 1996). Two forms are recognised: inshore (largely sedentary) and offshore (may undertake migration). Data suggest offshore whales may migrate seasonally, heading towards warmer tropical waters during the winter, however, information on migration is not well known (McCauley and Duncan, 2011). There is some taxonomic confusion, with Bryde's whales bearing similarity to, and being historically confused with, the sei whale (Bannister et al., 1996), particularly in whaling catch statistics (Slijper et al., 1964).

Bryde's whales may transit seasonally through a broad area of the continental shelf in the NWMR, including the Operational Areas and EMBA (McCauley and Duncan, 2011; RPS Environment and Planning, 2012c). This species has been detected within the Northwest Province from mid-December to mid-June, peaking in late February to mid-April (RPS Environment and Planning 2012c). As such, the species may be seasonally encountered within the Operational Areas, and is expected to occur in the EMBA, particularly in oceanic and continental slope waters.

Fin Whale

The fin whale is a large baleen whale with a cosmopolitan distribution in all ocean basins between 20 and 75 °S (Department of Environment and Heritage, 2005a). The global population of fin whales was reduced significantly by commercial whaling, with the species being targeted due to its large size and broad distribution. Like other baleen whales, fin whales migrate annually between high latitude summer feeding grounds and lower latitude over-wintering areas (Bannister et al., 1996).

Fin whales are thought to follow oceanic migration paths, and are uncommonly encountered in coastal or continental shelf waters. The Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving areas in Australian waters (Morrice et al., 2004). There are also no known BIAs for fin whales in the NWMR. Fin whales are likely to infrequently occur within the Operational Areas. Occurrence within the Operational Areas and offshore areas of the EMBA is likely to be mostly restricted to one or a few individuals occasionally transiting the area, mainly during winter months when the species may move away from Antarctic feeding areas.

Humpback Whale

Humpback whales were identified as occurring within the Operational Areas and EMBA. The species undertakes regular seasonal migrations between feeding grounds in the Southern Ocean and breeding and calving grounds off northern Western Australia, particularly Camden Sound (Jenner et al., 2001). Calving typically occurs at the northern extent of the migration corridor (beyond the EMBA). The humpback whale population that migrates along the Western Australian coast has been estimated to be as large as 33,300 in 2008, and has recovered significantly since the cessation of commercial whaling (Bejder et al., 2016).

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

From the North West Cape, north-bound humpback whales travel along the edge of the continental shelf passing to the west of the Muiron, Barrow and Montebello Islands (**Figure 4-11**), peaking in late July (Jenner et al., 2001). The southern migratory route follows a relatively narrow track between the Dampier Archipelago and Montebello Islands, north-east of the Operational Areas. Exmouth Gulf and Shark Bay are known resting/aggregation areas for southbound humpback whales, and are recognised resting BIAs. In particular, Exmouth Gulf is where cow/calf pairs may stay for up to two weeks during September (Jenner et al., 2001). Both the Exmouth Gulf and Shark Bay resting BIAs are about 17 km and 325 km, respectively, from the Operational Area (Operational Area 2).

Noise logger deployment conducted near the Greater Western Flank 2 development detected humpback whales present at the end of September, likely migrating south, and from late June to mid-August in deeper water, nearer to the continental shelf, likely migrating north (RPS Environment and Planning, 2012c). The southward migration of cow/calf pairs is slightly later during October (extending into November and December). During the southbound migration, it is likely that most individuals, particularly cow/calf pairs, stay closer to the coast than the northern migratory path. The peak of the northward migration in the vicinity of the Operational Areas is during July, whilst the southern migration peak is late August/early September. Humpback whales may occur within the Operational Areas and EMBA during these migration periods.

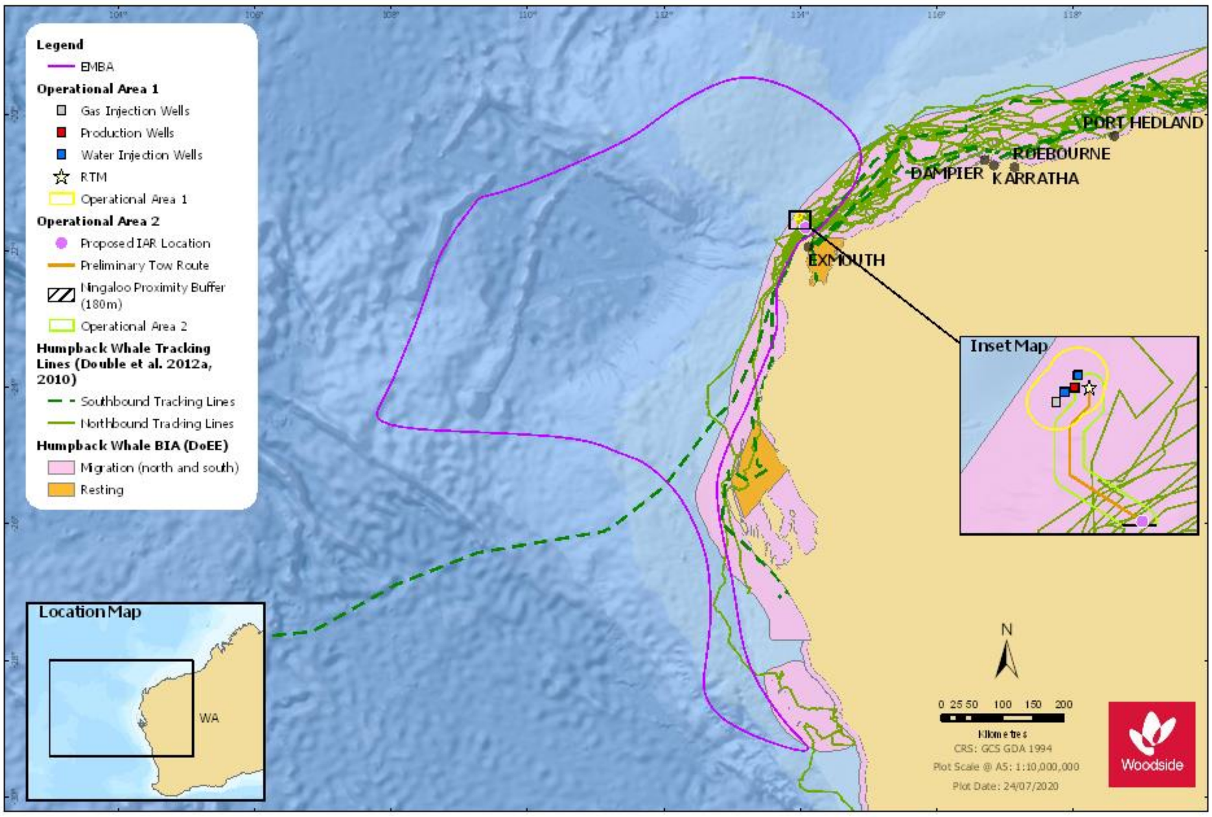


Figure 4-11: Humpback whales satellite tracks and BIAs

(Double et al., 2012a, 2010)

Sei Whale

Sei whales were identified as potentially occurring within the Operational Areas and EMBA. Sei whales have a worldwide oceanic distribution, and are expected to migrate seasonally between low latitude wintering areas and high latitude (Antarctic) summer feeding grounds (Bannister et al., 1996; Prieto et al., 2012). Sei whales have been infrequently recorded in Australian waters (Bannister et al., 1996), which could be due to the similarity in appearance of sei whales and Bryde's whales leading to incorrect recordings.

They have been sighted inshore (in the proximity of the Bonney upwelling, Victoria) as well as in deeper offshore waters and have only been sighted in summer and autumn. There are no known mating or calving areas in Australian waters (Department of the Environment and Energy (DoEE) 2019). While sei whales have been sighted inshore (in the proximity of the Bonney Upwelling, Victoria), they prefer deep waters and typically occur in oceanic basins and continental slopes (Prieto et al., 2012); records of the species occurring on the continental shelf (<200 m water depth) are uncommon in Australian waters (Bannister et al., 1996). Neither the Operational Areas nor EMBA are considered critical habitat for sei whales. Sei whales are likely to occur within the Operational Areas and EMBA.

Southern Right Whale

Southern right whales were identified as potentially occurring within the EMBA. The southern right whale occurs primarily in waters between around 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, such as Doubtful Island Bay, east of Israelite Bay and to a lesser extent Twilight Cove (DSEWPaC 2012b).

During the calving season, between May and November, female southern right whales that are either pregnant or with calf can be present in shallow protected waters along the entire southern WA coast and west up to Two Rocks, north of Perth. Sightings in more northern waters are relatively rare; however, they have been recorded as far north as Exmouth (Bannister et al., 1996). Given the species prefers temperate waters and has rarely been recorded north of Exmouth, southern right whales are unlikely to occur within the Operational Areas or EMBA.

Sperm Whale

The sperm whale has a worldwide distribution in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges, averaging 20–30 nautical miles offshore (Bannister et al., 1996a). Within the EMBA, sperm whales have been recorded in deep water off North West Cape (Jenner et al., 2010, RPS Environment and Planning, 2010a) and appear to occasionally venture into shallower waters in other areas (RPS Environment and Planning, 2010b). The only key locality recognised in WA waters for sperm whales are foraging BIAs in the Perth Canyon, and on the outer continental shelf from Cape Naturaliste to south of Jurien, outside of the EMBA for the Petroleum Activities Program. A MC3D seismic survey campaign was conducted off the North West Cape, including the Operational Areas, over five months from December 2016 to April 2017, which recorded 65 whale sightings (of variable pod sizes), and 23 of those sightings were sperm whales. These sperm whale sightings occurred approximately 50 km offshore and in water depths between 500–1000 m depth (Woodside Energy Limited, 2019). Given the wide distribution of sperm whales and their preference for deeper oceanic waters, the Operational Areas and EMBA is unlikely to represent an important habitat for this species. Their presence is likely to be a rare occurrence and limited to individuals infrequently transiting the area.

Cetaceans – Dolphins and Porpoises

Killer Whale

Killer whales are found in all of the world's oceans, from the Arctic and Antarctic regions to tropical seas (Department of Environment, 2013a; Ford at al., 2005), and have been recorded off all states of Australia (Bannister et al., 1996). 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).

Anecdotal evidence suggests killer whales may feed on dugongs in Shark Bay (outside the EMBA), between June and August (Department of Environmental Protection, 2001), but there are no recognised key localities or important habitats for killer whales within the Operational Areas or EMBA. The presence of killer whales is likely to be a rare occurrence and limited to individuals infrequently transiting the EMBA, with a very low likelihood of them transiting the Operational Areas.

Spotted Bottlenose Dolphin (Arafura/Timor Sea Populations)

There are four known subpopulations of spotted bottlenose dolphins, of which the Arafura/Timor Sea populations were identified as potentially occurring within the Operational Areas and the EMBA. The species occurs in open coastal waters, primarily within the continental shelf, and within the coastal waters of oceanic islands from Shark Bay to the western edge of the Gulf of Carpentaria. The species forages in a wider range of habitats and within deeper waters than most dolphin species, but is generally restricted to water depths of less than 200 m (DSEWPaC, 2012a).

The Arafura/Timor Sea spotted bottlenose dolphin population is considered migratory; however, its movement patterns are considered highly variable, with some individuals displaying year-round residency to a small area and others undertaking long-range movements and migrations (DSEWPaC, 2012a). Given the distribution of spotted bottlenose dolphins and their preference for shallow coastal waters, the Operational Areas is unlikely represent an important habitat for this species. Their presence is likely to be a remote and limited to infrequent transiting of the area, although they are expected to occur in the EMBA.

4.4.3.3 Marine Reptiles

Marine Turtles

Five of the six marine turtle species recorded for the NWMR have the potential to occur within the Operational Areas and EMBA (**Appendix C**) the loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle and the flatback turtle.

With consideration of the distance offshore, depth range of surrounding offshore waters (400–600 m), and absence of potential nesting or foraging sites (i.e. no emergent islands, reef habitat or shallow shoals) the Operational Areas is not considered an important habitat for marine turtles.

Four of the turtle species (green, loggerhead, flatback and hawksbill) have significant nesting rookeries on beaches along the mainland coast and islands in the EMBA including Ningaloo Coast, North West Cape, Lowendal islands, Muiron Islands, Gnaraloo Bay and Dirk Hartog Island (Commonwealth of Australia, 2017; Limpus, 2009, 2008a, 2008b, 2007). **Table 4-8** provides additional details of the marine turtle species identified, including breeding and nesting seasons, diet and key habitats (including BIAs) within the NWMR (including areas outside of the EMBA).

Table 4-8: Key information on marine turtles in the North-west Marine Region

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
Green Turtle	**Breeding**: Approximately September to December **Nesting**: November to March. Peak period from December to February.	Seagrasses and algae.	**Preferred habitat**: Nearshore reef habitats in the photic zone. **Distribution**: Ningaloo coast to Lacepede Islands. **Major nesting sites**: Adele Island, Maret Island, Cassini Island, Lacepede Islands, Barrow Island, Montebello Islands (all with sandy beaches), Serrurier Island, Dampier Archipelago, Thevenard Island, North West Cape, Ningaloo Coast (Commonwealth of Australia, 2017). **Internesting habitat**: Generally within 10 km of nesting beaches (Waayers et al., 2011). **Nearest BIA**: Refer to **Table 4-5** and **Table 4-6** for BIAs/habitat critical to the survival of a species* within the Operational Areas and EMBA.
Loggerhead Turtle	**Breeding**: Approximately September to March **Nesting**: November to March. Peak period in January.	Carnivorous – feeding mainly on molluscs and crustaceans	**Preferred habitat**: Nearshore and island coral reefs, bays and estuaries in tropical and warm temperate latitudes. **Distribution**: Shark Bay to North West Cape and as far north as Muiron Islands and Dampier Archipelago. **Major nesting sites**: Principally from Dirk Hartog Island, along the Gnaraloo and Ningaloo coast to North West Cape and the Muiron Islands. There have been occasional records from Varanus and Rosemary Islands in the Pilbara. Late summer nesting recorded for Barrow Island, Lowendal Islands and Dampier Archipelago. **Internesting habitat**: Limited data on Australian loggerhead turtles, however literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (Commonwealth of Australia, 2017). Nearest BIA: Refer to **Table 4-5** and **Table 4-6** for BIAs/habitat critical to the survival of a species* within the Operational Areas and EMBA.

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
Hawksbill Turtle	**Breeding**: All year round **Nesting**: All year round with peak in October to January.	Mainly sponges – also seagrasses, algae, soft corals and shellfish.	**Preferred Habitat**: Nearshore and offshore reef habitats. **Distribution**: Shark Bay north to Dampier Archipelago. **Major nesting sites**: The most significant rookery in WA is at Rosemary Island. Other rookeries include Varanus Island in the Lowendal group, some islands in the Montebello group and along the Ningaloo coast (Limpus 2009). **Internesting habitat**: Limited data on Australian hawksbill turtles, however literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (Commonwealth of Australia, 2017). **Nearest BIA**: Refer to **Table 4-5** and **Table 4-6** for BIAs/habitat critical to the survival of a species* within the Operational Areas and EMBA.
Flatback Turtle	**Breeding**: September to January **Nesting**: October to March with peak period in November and January.	Carnivorous – feeding mainly on soft bodied prey such as sea cucumbers, soft corals and jellyfish.	**Preferred Habitat**: Nearshore and offshore sub-tidal and soft bottomed habitats of offshore islands. **Distribution:** Shark Bay north to Dampier Archipelago. **Major nesting sites**: The largest nesting sites of the Pilbara region are Barrow Island and the mainland coast (Mundabullangana Station near Cape Thouin and smaller nesting sites at Cemetery Beach in Port Hedland and Bell's Beach near Wickham). Other significant rookeries include Thevenard Island, the Montebello Islands, Varanus Island, the Lowendal Islands, and islands of the Dampier Archipelago. **Internesting habitat**: Up to 70 km from nesting beaches (Waayers et al., 2011; Whittock et al., 2014). Satellite tracking of flatback turtle nesting populations at Barrow Island indicates that this species travels to the east of Barrow Island, towards WA mainland coastal waters, between nesting events. **Nearest BIA**: Refer to **Table 4-5** and **Table 4-6** for BIAs/habitat critical to the survival of a species* within the Operational Areas and EMBA.
Leatherback Turtle	No confirmed nesting activity in Western Australia.	Carnivorous – feeding mainly in the open ocean on jellyfish and other soft-bodied invertebrates.	**Preferred Habitat**: Nearshore, coastal tropical and temperate waters, may be encountered within the NWMR but noted that there are no known nesting sites within the NWMR. **Nearest BIA/Critical Habitat:** No known BIAs for leatherback turtles in the Operational Area or EMBA.

** Habitat critical to the survival of a species identified in the Recovery Plan for Marine Turtles in Australia 2017–2027 (Commonwealth of Australia, 2017) see Section 4.4.3.1*

Post-nesting migratory routes for green, hawksbill and flatback turtles recorded for the NWMR (Barrow Island and mainland sites) (Chevron Australia Pty Ltd, 2015) and green turtle tracking for post-nesting individuals from Scott Reef (Guinea, 2009), indicated no overlap with the Operational Areas or the EMBA. Green, flatback and hawksbill turtles travelling from nesting sites to foraging grounds generally travelled east or south of Barrow Island and around or through the Dampier Archipelago and along the coast towards foraging grounds to the north (north of Broome). The hawksbill turtle is an exception as it tends to travel south to the coastal island chain south of Barrow Island (Chevron Australia Pty Ltd, 2015).

Tracking data indicate the three marine turtle species recorded for the NWMR travel and forage in coastal waters that are relatively shallow (Chevron Australia Pty Ltd, 2015) as follows:

- Hawksbill turtles – less than 10 m deep
- Green turtles – less than 25 m deep
- Flatback turtles – less than 70 m deep.

Based on the results of tagging studies, along with the absence of suitable foraging habitat in the Operational Area, flatback turtles are considered unlikely to be encountered within the Operational Areas. However, the species is expected to occur within the EMBA, particularly in the vicinity of known nesting beaches between October and March.

Seasnakes

Seasnakes occur along the NWS and are reported to occur in offshore and nearshore waters. They occupy diverse habitats including coral reefs, turbid water habitats and deeper water (Guinea et al., 2004). Species exhibit habitat preferences depending on water depth, benthic habitat, turbidity and season (Heatwole and Cogger, 1993). The majority of information on the occurrence of seasnakes has been sourced from bycatch logs maintained by the Northern Prawn Fishery (DEWHA, 2008).

The short-nosed seasnake (*Aipysurus apraefrontalis*), listed as Critically Endangered under the EPBC Act, was identified as potentially occurring within Operational Area 2 and the EMBA. This species has been recorded on the Sahul Shelf, in particular at Ashmore and Hibernia reefs, as well as Exmouth Gulf, and is strongly associated with shallow (<10 m) reef habitat.

Seasnakes of the families Hydrophidae and Laticaudidae are widespread in the EMBA and are protected under the EPBC Act. The Protected Matters search identified 15 species of seasnake listed as marine under the EPBC Act within the EMBA (**Appendix C**) The most commonly sighted seasnake in the region is the olive seasnake (*Aipysurus laevis*), which is generally found along lower reef edges and upper lagoon slopes of leeward reefs. The olive seasnake is associated with shallow water, as large, deepwater expanses create a significant barrier to movement. Given the water depth of the Operational Areas, seasnake sightings will be infrequent and likely comprise few individuals.

4.4.3.4 Fishes and Elasmobranchs

Seahorses and Pipefish

A total of 46 species of pipefish and seahorse (**Appendix C**) protected under the EPBC Act are identified as potentially occurring within the EMBA, however, bycatch data (Department of Fisheries 2010) indicate they are uncommon in deeper continental shelf waters (50–200 m) and therefore are unlikely to occur within the Operational Areas. This family (Syngnathidae) are commonly found in seagrass and sandy habitats around coastal islands and shallow reef areas along the NWS, and is likely to be found in coastal areas including the Ningaloo area. Recent data collected using Baited Remote Underwater Video Stations at Rankin Bank and Glomar Shoals did not record any seahorses or pipefish (AIMS, 2014). Seahorses and pipefish may be encountered in a wide variety of shallow habitats, including seagrass meadows, reefs and sandy substrates within the EMBA.

Sawfish

<u>Narrow Sawfish</u>

The narrow sawfish occurs from the northern Arabian Gulf to Australia and north to Japan. Like other sawfish in the family *Pristidae*, the narrow sawfish prefers shallow coastal, estuarine and riverine habitats, although may occur in waters up to 40 m deep (D’Anastasi et al., 2013). In Australia, the species may have a broad tropical distribution from approximately North West Cape in Western Australia to southern Queensland.

Like other sawfish species, the narrow sawfish has experienced considerable decline in numbers due to human activities, including fishing and habitat loss/damage (Cavanagh et al., 2003). They are not currently listed as threatened but are commonly caught as bycatch (Morgan et al., 2010). Given their depth and habitat preference, narrow sawfish are not expected to occur within the Operational Areas and would only be infrequently encountered within the shallower waters of the EMBA.

Dwarf Sawfish

Dwarf sawfish are found in Australian coastal waters extending north from Cairns around the Cape York Peninsula in Queensland to the Pilbara coast (Kyne et al., 2013). Dwarf sawfish typically inhabit shallow (2 to 3 m) silty coastal waters and estuarine habitats, occupying relatively restricted areas and moving only small distances (Stevens et al., 2008). Juvenile dwarf sawfish use estuarine habitats in north-western WA as nursery areas (Thorburn et al., 2008; Threatened Species Scientific Committee, 2009), and migrate to deeper waters as adults. Most capture locations for the species in WA waters have occurred within King Sound (outside the EMBA) and the lower reaches of the major rivers that enter King Sound, including the Fitzroy, Mary and Robinson rivers (Morgan et al., 2010b). Individuals have also been recorded from Eighty Mile Beach (outside the EMBA), and occasionally have also been taken as by-catch from considerably deeper water from trawl fishing (Morgan et al., 2010b). The dwarf sawfish may be present in coastal waters within Operational Area 2.

Green Sawfish

The green sawfish was identified as potentially occurring within Operational Area 2. The species was once widely distributed in coastal waters along the northern Indian Ocean, although it is believed that northern Australia may be the last region where significant populations exist (Stevens et al., 2005). Within Australia, green sawfish are currently distributed from about the Whitsunday Islands in Queensland across northern Australian waters to Shark Bay in Western Australia (Commonwealth of Australia, 2015d). Preferred habitat for green sawfish includes shallow coastal waters and tidal creeks (Chevron Australia, 2014). Despite records of the species in deeper offshore waters, green sawfish typically occur in the inshore fringe with a strong association with mangroves and adjacent mudflat habitats (Commonwealth of Australia, 2015b; Stevens et al., 2005). Movements within these preferred habitats correlate with tidal movements (Stevens et al., 2008).

The Sawfish and River Sharks Multispecies Recovery Plan indicates that this species ‘known to occur’ distribution includes offshore waters of the NWS, with ‘known’ pupping areas in coastal waters north of Port Hedland to Roebuck Bay and pupping ‘likely to occur’ south of Port Hedland, Exmouth Gulf and North West Cape (Commonwealth of Australia, 2015b). Green sawfish may be present in coastal waters within Operational Area 2.

Sharks

Whale Shark

The whale shark was identified as potentially occurring within the EMBA and Operational Areas. Whale sharks aggregate annually to feed in the waters of the Ningaloo Coast (this foraging BIA lies about 14 km south of Operational Area 2, within the EMBA) from March to July with the largest numbers recorded in April and May (Sleeman et al., 2010). However, seasonal aggregation can be variable, with individual whale sharks recorded at other times of the year. The population (comprising individuals that visit the reef at some point during their lifetime) has been estimated to range between 300 and 500 individuals and it is expected that the number visiting Ningaloo reef in any given year will be somewhat smaller (Meekan et al., 2006). Timing of the whale shark migration to and from Ningaloo coincides with the coral mass spawning period when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo Reef. At Ningaloo Reef, whale sharks stay within a few kilometres of the shore and in waters approximately 30–50 m deep (Wilson et al., 2006).

After the aggregation period, the distribution of the whale sharks is largely unknown. Tagging, aerial and vessel surveys suggest that the group disperses widely, up to 1800 km away. Satellite tracking has shown that the sharks may follow three migration routes from Ningaloo (Meekan and Radford 2010, Wilson et al., 2006) (**Figure 4-12**):

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

These studies provided the justification for a foraging BIA for whale sharks which lies to the east and north-east of Operational Area 2 (about 7 km at the closest point), as shown in **Figure 4-12.** Though the BIA has been defined as a foraging area for whale sharks, it is more likely to be a migration pathway with whale sharks undertaking opportunistic foraging. While no BIAs overlap the Operational Areas, it is expected that whale sharks may traverse the vicinity of the Operational Areas during their migrations to and from Ningaloo Reef. However, it is expected that whale shark presence within the area would be of a relatively short duration and not in significant numbers, given the main aggregations are recorded in coastal waters, particularly the Ningaloo Reef edge (Department of Conservation and Land Management, 2005).

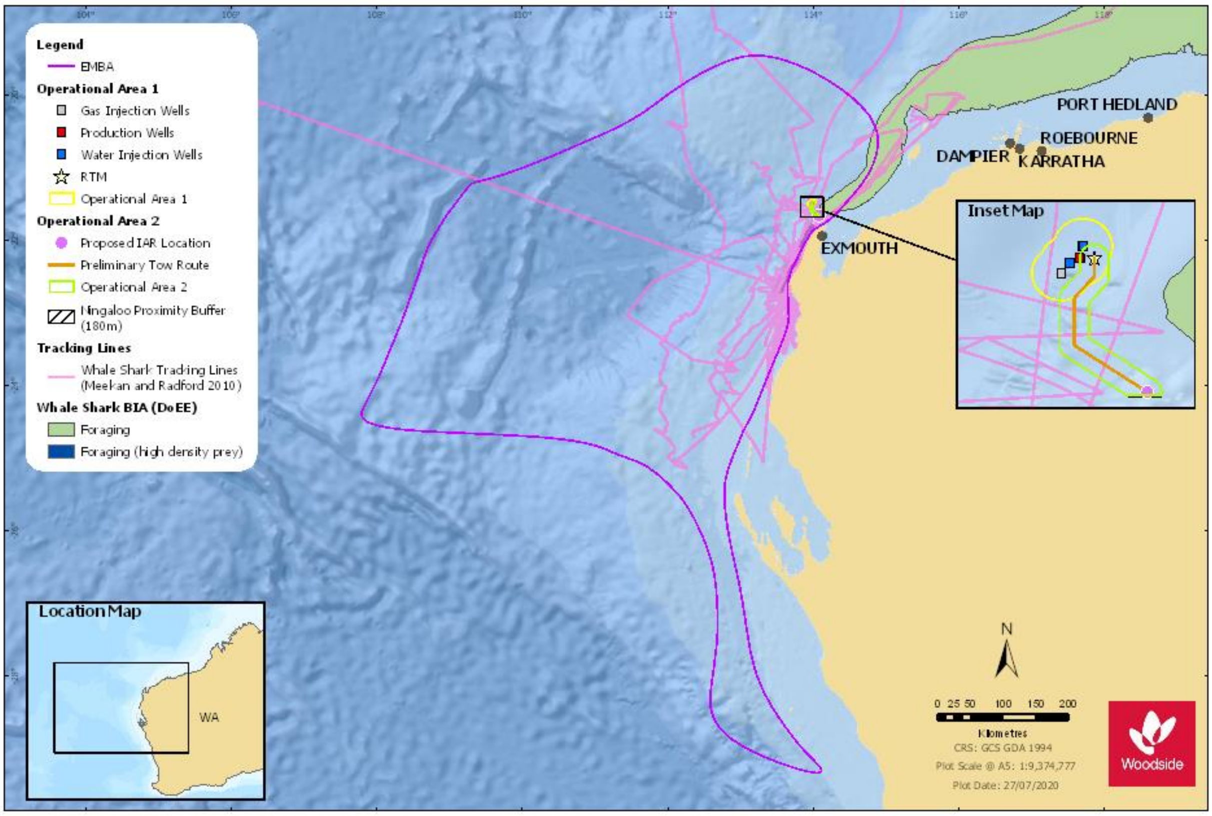


Figure 4-12: Satellite tracks of whale sharks tagged between 2005 and 2008

(after Meekan and Radford, 2010)

<u>Great White Shark</u>

The great white shark was identified as potentially occurring within the Operational Areas. 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, 2008, Bruce et al., 2006). They are also known to make open ocean excursions of several hundred kilometres and can cross ocean basins (Weng et al., 2007a, 2007b). Although great white sharks are not known to form and defend territories, they are known to return to on a seasonal/regular basis to regions with high prey density, such as pinniped colonies (Bruce, 2008).

Given the migratory nature of the species, its low abundance, broad distribution in temperate waters across southern Australia and absence of preferred prey (pinnipeds), great white sharks are unlikely to occur within the Operational Areas or EMBA. No BIAs for great white sharks overlap the Operational Areas or EMBA.

Grey Nurse Shark

The grey nurse shark was identified as potentially occurring within Operational Area 2. The species has a broad distribution in inner continental shelf waters, primarily in subtropical to cool temperate waters. Off WA, the grey nurse shark occurs primarily in south-west coastal waters between 20 and 140 m depth (Chidlow et al., 2006). Grey nurse sharks have been documented as aggregating in specific areas (typically reefs); however, no clear aggregation sites have been identified off WA (Chidlow et al., 2006). A species recovery plan has been developed for the grey nurse shark, which describes mortality from fishing (both commercial and recreational) and shark mitigation devices (nets and baited lines) as the key threats, with ecotourism, collection for aquaria, pollution, disease and ecosystem effects of habitat modification and climate change as potential threats (DoE, 2014).

Given the species' preference for relatively shallow temperate waters, grey nurse sharks may occur within Operational Area 2.

Shortfin Mako

The shortfin mako shark is a pelagic species with a circumglobal, wide-ranging oceanic distribution in tropical and temperate seas (Mollet et al., 2000). It is identified as potentially occurring within the Operational Areas. The shortfin mako is commonly found in water with temperatures greater than 16 °C and can grow to almost 4 m. Females mature later (19 to 21 years) than males (seven to nine years) and adults have moderate longevity estimates of 28 to 29 years (Bishop et al., 2006). The shortfin mako shark is an apex and generalist predator that feeds on a variety of prey, such as teleost fish, other sharks, marine mammals and marine turtles (Campana et al., 2005). Tagging studies indicate shortfin makos spent most of their time in water less than 50 m deep but with occasional dives up to 880 m (Abascal et al., 2011; Stevens et al., 2010). Little is known about the population size and distribution of shortfin mako sharks in Western Australia, however it is possible they will transit the Operational Areas and EMBA. No BIAs for the shortfin mako overlap the Operational Areas or EMBA.

Longfin Mako

The longfin mako is a widely distributed but rarely encountered oceanic shark species. The species can grow to just over 4 m long and is found in northern Australian waters, from Geraldton in Western Australia to at least Port Stephens in New South Wales. It is uncommon in Australian waters relative to the shortfin mako (Bruce, 2013; Department of the Environment, Water, Heritage and the Arts, 2010). There is very little information about these sharks in Australia, with no available population estimates or distribution trends. A study from southern California documented juvenile longfin mako sharks remaining near surface waters, while larger adults were frequently observed at greater maximum depths of about 200 m (Sepulveda et al., 2004). Longfin mako may occur in the Operational Areas and broader EMBA but, given their widespread distribution and apparent low density they are likely to be uncommon. No BIAs for the longfin mako overlap the Operational Areas or EMBA.

Scalloped Hammerhead

The scalloped hammerhead is not currently included in the EPBC Act Protected Matters Search; however, the species is Conservation Dependent under the EPBC Act. Scalloped hammerheads are large sharks which are widely distributed in tropical and subtropical waters, primarily inhabiting shallow coastal shelfs. In Australian waters the species ranges from Geographe Bay in WA, around the northern coast to Wollongong in New South Wales (Harry et al., 2011). On the east coast of Australia pupping occurs year round, peaking during November and December, with juveniles remaining in shallow inshore habitats (Harry et al., 2011). The species is highly mobile but rarely ventures into deep offshore waters. Scalloped hammerheads are likely to occur within the Operational Areas and EMBA.

Rays

Giant Manta Ray

The giant manta ray is broadly distributed in tropical waters of Australia. The species primarily inhabits nearshore environments along productive coastlines with regular upwelling, but they appear to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall et al., 2011). The Operational Areas are not located in or adjacent to any known key aggregation areas for the species (e.g. feeding or breeding). However the Ningaloo Reef, about 1 km south-west of Operational Area 2 within the EMBA, is an important area for giant manta rays in autumn and winter (Preen et al., 1997). Occurrence of giant manta rays within the Operational Areas is likely to be infrequent, and restricted to individuals transiting the area. No BIAs for the giant manta ray overlap the Operational Areas or EMBA.

Reef Manta Ray

The reef manta ray was identified as potentially occurring within Operational Area 2. The species is commonly sighted inshore, but also found around offshore coral reefs, rocky reefs and seamounts (Marshall et al., 2009). In contrast to the giant manta ray, long-term sighting records of the reef manta ray at established aggregation sites suggest this species is more resident in tropical waters, and may exhibit smaller home ranges, philopatric movement patterns and shorter seasonal migrations than the giant manta ray (Deakos et al., 2011; Marshall et al., 2009). A resident population of reef manta rays has been recorded at Ningaloo Reef, and the species has been shown to have both resident and migratory tendencies in eastern Australia (Couturier et al., 2011). Occurrence of reef manta rays within Operational Area 2 is likely to be infrequent, and restricted to individuals transiting the area. The reef manta ray may also occur in continental shelf waters of the EMBA.

Pelagic Fish

Southern Bluefin Tuna

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

4.4.3.5 Birds

Oceanic Seabirds and/or Migratory Shorebirds

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

The Operational Areas may be occasionally visited by migratory and oceanic birds but does not contain any emergent land that could be utilised as roosting or nesting habitat and contains no known critical habitats (including feeding) for any species. Thirteen species of listed birds were identified by the EPBC Act Protected Matters search (**Appendix C**) for the Operational Areas (**Table 4-3**).

One BIA (for the migratory wedge-tailed shearwater) overlaps both Operational Areas, which relates to breeding between mid-August and April in the Pilbara; note the PMST report did not identify wedge-tailed shearwaters within the Operational Areas.

Within the EMBA, there are numerous important habitats for seabirds and migratory shorebirds including key breeding/nesting areas, roosting areas and surrounding waters, important foraging and resting areas within the NWMR. These include (approximate distances from Operational Area 2 shown in brackets:

- Muiron Islands (15 km to Marine Management Area)
- Pilbara Islands (North, Middle and South groups [60 km or more to closest State Nature Reserves, respectively])
- Shark Bay (429 km)
- Houtman Abrolhos Islands (608 km).

These habitats are discussed further as key environmental sensitivities in **Section 4.6**.

<u>Australian Fairy Tern</u>

The Australian fairy tern was identified as potentially occurring within the Operational Areas. The species is a widely distributed shorebird and occurs along the coasts of New South Wales, Victoria, Tasmania, South Australia and Western Australia (Threatened Species Scientific Committee, 2011a). In Western Australia, the species occurs along the coast as far north as the Dampier Archipelago and offshore islands Barrow/Montebello/Lowendal Islands Group (Threatened Species Scientific Committee, 2011b, 2011a). No BIAs for the Australian fairy tern overlap the Operational Areas, however, a breeding BIA on the Ningaloo Coast (about 15 km south of Operational Area 2), and foraging BIA on the Houtman Abrolhos Islands (approximately 704 km south of Operational Area 2) were identified within the EMBA.

Usage of this BIAs is seasonal, with the species typically found in the region during July, August and September (CALM, 2005; Environment Australia, 2002). Australian fairy terns nest above the high water mark in sandy substrates where vegetation is low (Threatened Species Scientific Committee, 2011a). Australian fairy terns feed primarily on small schooling fish, and are rarely encountered beyond sight of land (BirdLife International, 2014). Given the species' preference for coastal waters, the Australian fairy tern is unlikely to be encountered within the Operational Areas, but may occur within the EMBA in littoral environments.

Common Noddy

The common noddy is the largest species of noddy found in Australian waters. The species is widespread in tropical and subtropical areas beyond Australia. This seabird typically forages in coastal waters around nesting sites, taking prey such as small fish, but may occur longer distances out to sea. Nesting occurs broadly across tropical and subtropical Australia in coastal areas, particularly on islands such as the Houtman Abrolhos island group (Burbidge and Fuller, 1989). The common noddy is thought to undertake seasonal movements, with some nesting sites abandoned during the non-breeding season (which is protracted between spring and autumn). The species may occur within the Operational Areas and the EMBA, particularly around offshore and coastal islands.

Common Sandpiper

The common sandpiper is a small bird with a very large range through which it migrates annually between breeding grounds in the northern hemisphere (Europe and Asia) and non-breeding areas in the Asia-Pacific region (Bamford et al., 2008). In Australia, the species congregates in large flocks and forages in shallow waters and tidal flats between spring and autumn. Specific critical habitat in Australia has not been identified due to the species' broad distribution (Bamford et al., 2008). The presence of the common sandpiper within the Operational Areas and EMBA is likely to be restricted to when they transit through during seasonal migration periods.

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 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. Their presence in the Operational Areas and EMBA is likely to be restricted to when they transit through the area during their seasonal migration periods.

Pectoral Sandpiper

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

Sharp-tailed Sandpiper

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

Eastern Curlew

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

Flesh-footed Shearwater

The flesh-footed shearwater was identified as potentially occurring within the Operational Areas, and the species mainly occurs in the subtropics, over continental shelves and slopes and occasionally inshore waters, with individual birds passing over deeper waters during migrations (Department of the Environment and Energy, 2016). They are a common visitor to the waters off southern Australia, from south-western Western Australia 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 (Department of the Environment and Energy, 2016). No BIAs for the flesh-footed shearwater were identified within the Operational Areas or EMBA.

Lesser Frigatebird

The lesser frigatebird was identified as potentially occurring within the Operational Areas. It is usually seen in tropical or warmer waters around the coast of north Western Australia, the Northern Territory, Queensland and northern New South Wales (DSEWPaC 2012d). Within the North-west Marine Region the lesser frigatebird is known to breed on Adele, Bedout and West Lacepede islands, Ashmore Reef and Cartier Islands (DSEWPaC 2012d). The lesser frigatebird feeds mostly on fish and sometimes cephalopods and all food is taken while the bird is in flight. Lesser frigatebirds generally forage close to breeding colonies. No BIAs for the lesser frigatebird were identified within the Operational Areas or EMBA.

Osprey

The osprey was identified as potentially occurring within the Operational Areas. The osprey is a medium-sized raptor (length 50–65 cm; wingspan 145–170 cm) that is widely distributed around Australia in coastal and wetland habitats (Department of the Environment, 2016b). The species also occurs throughout south-eastern Asia (Indonesia, Philippines, Palau Islands, New Guinea, Solomon Islands and New Caledonia) (Department of the Environment, 2016b). Ospreys feed almost exclusively on fish, typically capturing prey observed while flying by plunging feet first into the water (Clancy, 2005). Whilst listed as migratory, adults are generally restricted to a foraging area surrounding their nests (Department of the Environment, 2016b). Egg laying in Australia is protracted between April and February (Olsen and Marples, 1993), which may be due to the extended geographic range of the species within Australia and discrete genetic populations that may constitute subspecies (Olsen and Marples, 1993; Wink et al., 2004). Given the species’ preference for coastal and wetland environments, it is unlikely to occur within the Operational Areas, but may occur within the EMBA in coastal waters. No BIAs for the osprey were identified within the Operational Areas or EMBA.

Red Knot

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

Soft-plumaged Petrel

The soft-plumaged petrel was identified as potentially occurring within the Operational Areas. As a mainly sub-Antarctic species they are usually seen in cooler seas but have been recorded off south-eastern Australia in waters between 10–21°C (Department of the Environment 2013b). The petrel is a marine oceanic species but occasionally occurs inland and may transit the Operational Areas and EMBA. No BIAs for the soft-plumage petrel were identified within the Operational Areas or EMBA.

Southern Giant Petrel

The southern giant petrel was identified as potentially occurring within the Operational Areas. The species is widespread throughout the Southern Ocean and breeds on six subantarctic and Antarctic islands within Australia (Patterson et al., 2008). The species is found mainly over Antarctic waters and migrates into subtropical waters during winter months. No critical habitat associated with the southern giant petrel has been identified for the Operational Areas or EMBA, and therefore the presence of this species within the Operational Areas is likely to be infrequent as individuals traverse the area. This is supported by the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011–2016, which identifies critical habitat for foraging in waters south of 25 degrees (DSEWPaC 2011). No BIAs for the southern giant petrel were identified in the Operational Areas or EMBA.

Streaked Shearwater

The streaked shearwater is a migratory seabird with a broad distribution in the western Pacific Ocean. During winter months the species migrates south, as far as northern Australia, where it occurs around islands and inshore waters (Yamamoto et al., 2010). Within Australian waters, the species is commonly distributed from Exmouth, across northern Australia to Queensland, south to New South Wales (DSEWPaC, 2012). Its diet comprises invertebrates and epipelagic fishes. The species breeds in temperate regions of East and Southeast Asia before migrating to tropical regions near the equator; however, little is known about their movements during the non-breeding period (Yamamoto et al., 2010). The species may occur within Operational Area 2 and EMBA during winter months.

Wedge-tailed Shearwater

The wedge-tailed shearwater is a migratory seabird with a broad distribution in the Indian and Pacific Oceans. Within Australian waters, the species is commonly found across the Indian Ocean, Coral Sea and Tasman Sea (Lindsey, 1986). The species breeds on offshore island on the east and west coasts of Australia, and at Cocos-Keeling Island (Lindsey, 1986). In WA the species is present between August and April, with breeding between late October to early November (laying) and fledglings arriving mid May (Garkaklis et alm 1998; Marchant and Higgins, 1990). Wedge-taield shearwaters spend winters in the Tropics north of the equator. The species will occur within the Operational Areas and EMBA during between August and April, with a peak period during breeding season in November.

4.5 Socio-economic and Cultural

4.5.1 Cultural Heritage

4.5.1.1 European and/or Indigenous Sites of Significance

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

Within the EMBA, Ningaloo Reef, Exmouth and the adjacent coastline have a long history of occupancy by Aboriginal communities. Indigenous heritage places are protected under the *Aboriginal Heritage Act 1972* (WA) or EPBC Act. A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System was undertaken for the shoreline within the socio-cultural EMBA (**Appendix G**). The search indicated there are numerous registered sites recorded, including middens, burial, ceremonial, artefacts, rock shelters, mythological and engraving sites recorded on the Montebello Islands (**Appendix G**). 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 hydrocarbon release, would involve prioritising further consultation with key contacts within DPLH and local Aboriginal communities (refer to **Section 6.6.2**).

4.5.1.2 Underwater Cultural Heritage

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

A search of the Australian National Shipwreck Database (Department of the Environment and Energy n.d.), which records all known Maritime Cultural Heritage (shipwrecks, aircraft, relics and other underwater cultural heritage) in Australian waters, indicated that there are two known Underwater Cultural Heritage sites within Operational Area 2 (*Beatrice* and *Gem*). However, a number of sites were identified within the EMBA; 28 of these (shipwrecks) were identified within 100 km of the Operational Areas (**Table 4-9**).

Table 4-9: Recorded historical shipwrecks in the vicinity of the Operational Areas

Vessel name	Year wrecked	Wreck location*	Latitude (D.MM °S)	Longitude (D.MM °E)	Distance from Operational Area (km)
Beatrice	1899	Off North West Cape	21.62	113.98	Overlaps Operational Area 2
Gem	1893	North West Cape	21.62	113.98	Overlaps Operational Area 2
Agnes	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Bell	1893	Exmouth	21.75**	114.08**	10 (Operational Area 2)
Elizabeth	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Ellen	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Florence	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Kapala	1964	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Lamareaux	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Leave	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Lily Of The Lake	1875	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Mabel	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Nellie	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Olive	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Pearl	1896	Exmouth Gulf, Meda Creek	21.75**	114.08**	10 (Operational Area 2)
Ruby	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Sea Queen	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Smuggler	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Unidentified lugger	1893	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)
Wild Wave	1875	Exmouth Gulf	21.75**	114.08**	10 (Operational Area 2)

** Wreck location as recorded in Australian National Shipwreck Database (Department of the Environment and Energy n.d.)*

*** Considered an unreliable generic location – refer to stated wreck location*

4.5.1.3 World, National and Commonwealth Heritage Listed Places[5]

There are no heritage listed sites within the Operational Areas; listed WHPs and National and Commonwealth Heritage Places within the EMBA consist of:

- WHPs:
  - Ningaloo Coast World Heritage Area (about 100 m south of the Operational Area 2)
- National Heritage places:
  - The Ningaloo Coast National Heritage Place (about 9 km south of Operational Area 2)
- Commonwealth Heritage places:
  - Ningaloo Marine Area (Commonwealth Waters) Commonwealth Heritage Place (about 100 m south of Operational Area 2).

Two additional National Heritage listed places occur within the socio-cultural EMBA, including the Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves Nominated Heritage Place (about 142 km north-east of the Operational Area), and HMAS Sydney II and HSK Kormoran Shipwreck Sites National Heritage Place (about 569 and 583 km south of Operational Area 2, respectively).

The significant values of the Ningaloo WHP, and National Heritage and Commonwealth Heritage Listed Places are outlined in **Section 4.6**.

4.5.2 Ramsar Wetlands

No Ramsar wetlands overlap the Operational Areas or the EMBA.

4.5.3 Fisheries – Commercial

4.5.3.1 Commonwealth and State Fisheries

A number of Commonwealth and State fisheries are located within the Operational Areas and EMBA. Fish Cube data were requested to analyse the potential for interaction of fisheries with the Operational Areas, which was used to determine consultation with State Fisheries who may be impacted by proposed petroleum activities (Department of Primary Industries and Regional Development [DPIRD], 2019a). **Table 4-10** provides further detail on the fisheries that have been identified through desk-based assessment and consultation (**Section 5**). **Figure 4-13**, **Figure 4-14**, and **Figure 4-15** show the designated fisheries management areas in relation to the Operational Areas.

[5] *World Heritage designations are addressed in* ***Section 4.7.***

Table 4-10: Commonwealth and State fisheries within the Operational Areas and EMBA (including the socio-cultural EMBA)

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Commonwealth Managed Fisheries				
North-West Slope Trawl Fishery	✓	✓	×	**Description**: The North West Slope Trawl Fishery licence area extends, from 114 °E to 125 °E, between the 200 m isobath and the outer boundary of the Australian Fishing Zone (AFZ) and Australian Exclusive Economic Zone (EEZ). The fishery overlaps Operational Area 1 and the tow route for Operational Area 2, however, does not overlap the proposed IAR location. The fishery traditionally targets scampi, deepwater prawns and mixed snappers. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 350–600 m using demersal trawl gear on the continental slope focussed in waters to the north-east of the Operational Areas and EMBA, from offshore Barrow Island north to the south of Ashmore Reef (Mazloumi et al., 2019a). Activity in the fishery commenced in 1985, peaking at 21 active vessels in 1986–1987. Activity has since decreased to stabilise at one or two active vessels each year since 2008–2009, operating from Point Samson and Darwin (Mazloumi et al., 2019a). Fishing effort (number of trawl-hours) in the fishery is closely related to vessel activity, which increased during 2017–2018 season. (Mazloumi et al., 2019a). **Licences/vessels**: four vessels active in 2017–2018 season (Mazloumi et al., 2019a).
Southern Bluefin Tuna Fishery	✓	✓	×	**Description**: The Southern Bluefin Tuna Fishery licence area overlaps the Operational Areas and EMBA, however current fishing effort is confined to southern and south-eastern Australia; within the Great Australian Bight, Tasmania and along the east coast of New South Wales (Patterson, et al., 2019). Southern bluefin tuna (*Thunnus maccoyii*) are known to spawn in the north-eastern Indian Ocean (Davis et al., 1990, Matsuura et al., 1997). The species has been heavily exploited by commercial fisheries worldwide. The fishery employs both longlining and purse seine net fishing methods, with the majority of fishing in Australia by purse-seine in the Great Australian Bight (Patterson et al., 2019). **Licences/vessels**: seven purse seine vessels, 31 longline vessels active in 2017–2018 season (Patterson et al., 2019)
Western Deepwater Trawl Fishery	✓	✓	×	**Description**: The Western Deepwater Trawl Fishery is located in deep water off Western Australia, between longitude115°08'E and the western boundary of the North West Slope Trawl Fishery in the north (114°E), to the outer boundary of the AFZ. The fishery overlaps Operational Area 1 and the tow route for Operational Area 2, however, does not overlap the proposed IAR location or the current location of the RTM. Recent changes to the boundary have occurred to align with the 200 m isobath (Mazloumi et al., 2019b). This fishery targets a number of deepwater, demersal finfish and crustacean species. The nominated fishing grounds are extensive, however, the fishing effort is to the south, offshore of the North West Cape, with areas of fishing activity located to along Ningaloo Reef, west of

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				Shark Bay, and offshore Perth Metropolitan area, in water greater than the 200 m isobath. Fishing effort increased during the 2017–2018 season compared to low effort in recent years after the early 2000's peak (Mazloumi et al., 2019b). **Licences/vessels**: three vessels active in 2017–2018 season (Mazloumi et al., 2019b).
Skipjack Tuna Fishery	✓	✓	×	**Description**: The combined Western and Eastern Skipjack Tuna (*Katsuwonus pelamis*) Fishery encompasses the entire Australian EEZ, including the Operational Areas and EMBA. The target species has historically been used for canning, and with the closure of canneries at Eden and Port Lincoln, effort in the fishery declined and there have been no active vessels operating since 2009 (Patterson and Mobsby, 2019). Should the fishery commence efforts in the future, fishing effort in the Operational Areas and EMBA is considered to be unlikely, given the historical fishery was concentrated off southern Australia. **Licences/vessels**: Fishery inactive. No vessels active in 2017–2018 season.
Western Tuna and Billfish Fishery	✓	✓	×	**Description**: The Western Tuna and Billfish Fishery zoning extends to the Australian EEZ boundary in the Indian Ocean, overlapping the Operational Areas and EMBA. Key species the fishery targets are four highly mobile pelagic species; swordfish (*Xiphias gladius*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*), striped marlin (*Kajikia audax*), some albacore tuna (*T. alalunga*) is also taken (Williams et al., 2019). Recent fishing effort is concentrated from offshore Point Cloates (Exmouth) south along the WA coast to Augusta in the southwest of WA (Williams et al., 2019). **Licences/vessels**: 94 statutory fishing rights, four vessels in 2017–2018 season, (SFRs; (Williams et al., 2019).
State Managed Fisheries				
Mackerel Managed Fishery	✓	✓	×	**Description**: The Mackerel Managed Fishery targets Spanish mackerel (*Scomberomorus commerson*) using near-surface trawling gear from small vessels in coastal areas around reefs, shoals and headlands. Jig fishing is also used to capture grey mackerel (*S. semifasciatus*), along with other species from the genera Scomberomorus (Lewis and Jones, 2017). 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). Managed Fishing Areas 2 and 3 overlap the Operational Areas. The catch is generally taken from the Pilbara and Kimberley coasts reflecting the tropical distribution of mackerel species (Molony et al., 2015). The fishing activity occurs around the coastal reefs of the Dampier Archipelago and Port Hedland area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development prior to spawning (Mackie et al., 2003). The catch effort in 2018–2019 was 214 t (DPIRD, 2019b).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				Spanish mackerel spawn between August and November when inhabiting coastal reef areas of the Exmouth/Gascoyne region, with females exhibiting serial spawning behaviour (spawning every one to three days) over the spawning period. Outside the main fishing season, it is unclear where the mackerel populations inhabit. However, there is anecdotal evidence to suggest populations move into deeper offshore waters (Mackie et al., 2003). There was limited fishing activity in the 60 nm grid (DPIRD, 2019a), however given fishing occurs in coastal areas around reefs, shoals and headlands it will not occur within the Operational Areas. **Licences/vessels**: 52 licences in 2017–2018 season (DPIRD, 2019b). 14 vessels in 2014 (Molony et al., 2015). Not stated from 2015 to 2018 (Lewis et al., 2018).
South West Coast Salmon Managed Fishery	✓	✓	×	**Description**: The South West Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all Western Australian waters north of Cape Beaufort except Geographe Bay. This fishery uses beach seine nets to take western Australian salmon (*Arripis truttaceus*). No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to the Western Australia/Northern Territory border. The fishery has not been active in the Operational Areas within the last five years (DPIRD, 2019a). **Licences/vessels**: not applicable (shore-based).
West Coast Deep Sea Crustacean Managed Fishery	✓	✓	×	**Description**: The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the Western Australia/Northern Territory border in water depths great than 150 m within the AFZ, including the Operational Areas. The fishery targets deepwater crustaceans, including crystal (snow) crabs, giant (king) crabs and champagne (spiny) crabs, with the vast majority (>99%) of the catch landed in 2017 comprising crystal crabs (How and Orme, 2018). Two vessels operated in the fishery in 2015, using baited pots operated in a longline formation in the shelf edge waters greater than 150 m water depths (How and Orme, 2018). The catch effort in 2019–18 was 152.8 t (DPIRD, 2019b) and was concentrated between Fremantle and Carnarvon. The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019a). **Licences/vessels**: Seven licences in 2017–2018 season (DPIRD, 2019b). Six vessels active in 2017–2018 season (How and Orme, 2018).
Pilbara Crab Managed Fishery	✓	✓	×	**Description:** Blue Swimmer Crabs (*Portunus armatus*) are targeted by the Pilbara Crab Managed Fishery, which came into force in 2018. As there are no recent status reports, the Pilbara crab resource had been commercially accessed through the Pilbara Developing Crab Fishery (Developing Fishery) since it commenced in 2001 (DPIRD, 2018). The fishing effort occurs in Nickol Bay, near Dampier. Crab stocks in the Pilbara region are highly variable due to environmental fluctuations. Total commercial catch of blue swimmer crabs was 51 t and mud crabs was 9 t in the North Coast Bioregion for 2017–2018 (Johnston et al., 2017).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				The fishery has not been active in the Operational Areas within the last five years (DPIRD, 2019a). **Licences/vessels**: not available.
West Australian Sea Cucumber Fishery	✓	✓	×	**Description:** The sea cucumber or 'Beche-de-mer' fishery is a hand-harvested fishery that can be conducted within all Western Australian waters. The collection methods of this fishery is limited to shallow, coastal waters (methods principally by diving or wading). This nearshore fishery was predominantly a single species fishery with 99% of the catch being sandfish (*Holothuria scabra*). A deepwater species redfish (*Actinopyga echinites*) has more recently emerged as a target species, but recent catch data indicate a rapid decline in the catch of this species (50% reduction in overall catch of the fishery from 2010 to 2011). The fishery was worth an estimated AU$400,000 in 2017–2018 (Hart et al., 2018b) with a total catch of 135 t. There are specific areas closed to this fishery including the Dampier Archipelago and Rowley Shoals (Department of Fisheries [DoF], 2012a). The catch effort in 2018 for the Pilbara region was 33 t (DPIRD, 2018). Fishing is usually concentrated in the northern half of the State from Exmouth Gulf to the Kimberley region (Hart et al., 2018b). There was previously vessels operating within a 60 nm block that partially enters the Operational Areas, however these have not operated in the block since at least 2014. (DPIRD, 2019a,b). **Vessels:** Not applicable (hand collection – shallow water-based).
Marine Aquarium Managed Fishery	✓	✓	×	**Description**: The Marine Aquarium Managed Fishery operates within Western Australian waters. The fishery overlaps Operational Area 2. The fishery is primarily a dive-based fishery that uses hand-held nets to capture the desired target species and is restricted to safe diving depths (typically <30 m). The fishery is typically active from Esperance to Broome, with popular areas including the coastal waters of the Cape Leeuwin/Cape Naturaliste region, Dampier and Exmouth. The landed catch was predominantly ornamental fish but also included hermit crabs, seahorses, invertebrates, corals and live rock (Newman et al., 2014). The fishery has not been active in Operational Area 2 within the last five years (DPIRD, 2019a). **Licences/vessels**: 11 licences in 2017–2018 (DPIRD, 2019; Newman et al., 2018).
Specimen Shell Managed Fishery	✓	✓	×	**Description**: The Specimen Shell Managed Fishery can be conducted anywhere within Western Australia waters and targets the collection of specimen shells for display, collection, cataloguing and sale. The fishery overlaps Operational Area 2; it encompasses the entire WA coastline but effort is concentrated in areas adjacent to the largest population centres such as: Broome, Karratha, Shark Bay, Mandurah, Exmouth, Capes area, Albany and Perth (Hart and Crowe, 2015). Collection is predominately by hand when diving or wading in shallow coastal waters, though a deeper water collection aspect to the fishery has been initiated with the employment of ROVs operating at depths up to 300 m (Hart and Crowe, 2015). The fishery has not been active in Operational Area 2 within the last five years (DPIRD, 2019a).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				Licences/vessels: 31 licences in 2017–2018, with 23 of these being active in 2017 (Hart et al., 2018c).
Western Australian Abalone Managed Fishery	✓	✓	×	**Description**: The Western Australian Abalone Managed Fishery includes all coastal waters from the Western Australian and South Australian border to the Western Australian and Northern Territory border. Shark Bay is considered the northern range limit for the commercial abalone species. The fishery overlaps Operational Area 2. Abalone are harvested by divers, limiting the fishery to shallow waters. The abalone fishery targets the greenlip abalone (*Haliotis laevigata*), brownlip abalone (*H. conicopora*) and Roe's abalone (*H. roei*). No commercial fishing for abalone north of Moore River (zone 8 of the managed fishery) took place in 2015 (Hart et al., 2015a). The commercial fishery reported a total commercial catch of 61 t in 2018–2019 (DPIRD, 2019b). The fishery has not been active in Operational Area 2 within the last five years (DPIRD, 2019a). **Licences/vessels**: 23 vessels active in Roe's abalone fishery in 2017 (Strain et al., 2018c).
Pilbara Demersal Scalefish Fisheries (Pilbara Trawl, Trap and Line)	×	✓	×	**Description**: The Pilbara Demersal Scalefish Fishery (PDSF), which is about 10 km from Operational Area 2, targets a range of low and high value finfish species. The fishery includes the Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF), the Pilbara Trap Managed Fishery (PTMF) and the Pilbara Line Fishery (PLF; Newman et al., 2017). The PDSF collectively use a combination of vessels, effort allocations (time), gear limits, plus spatial zones (including extensive trawl closures) as management measures (Newman et al., 2017). The PFTIMF targets more than 50 species of Scalefish, the PTMF and PLF fisheries target 40–50 species, with the line fishery targeting additional offshore species such as ruby snapper (*Etelis carbunculus*) and eightbar grouper (*Hyporthodus octofasciatus*) (Newman et al., 2017). The PFTIMF is divided into two zones, waters inside the 50 m isobath are permanently closed to fish trawling, Zone 1 is closed to fish trawling, Zone 2 comprises six management areas and Area 3 is permanently closed to trawling, Area 6 has had no fish trawl effort allocation since 1998 (Newman et al., 2017). The PFTIMF lands the largest component of the catch and operates in waters between 50 and 200 m depth (Newman et al., 2015b; 2017). The PTMF covers the area from Exmouth northwards and eastwards to the 120° line of longitude, and offshore as far as the 200 m isobath. Like the trawl fishery, the trap fishery is also managed by the use of input controls in the form of individual transferable effort allocations monitored with a satellite-based vessel monitoring system. Waters inside the 50 m isobath are permanently closed to trap fishing and Area 3 has also been closed to trapping since 1998 (Newman et al., 2015b). Traps are limited in number with the greatest effort in waters less than 50 m deep. This fishery targets high value species such as red emperor and goldband snapper (Newman et al., 2019).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				The PLF encompasses all 'Pilbara waters', extending from a line commencing at the intersection of 21°56'S latitude and the boundary of the AFZ and north to longitude 120°E (Newman et al., 2014). The PLF targets tropical demersal scalefish and is the smallest scale fishery in terms of monetary value, attaining a commercial catch of 40 tonnes (Newman et al., 2015b). There are no stated depth limits and the western extent of the fishery is the boundary of the AFZ (Newman et al., 2015b). The PLF is managed under the Prohibition on Fishing by Line from Fishing Boats (Pilbara Waters) Order 2006 with the exemption of nine fishing vessels for any nominated five-month block period within the year. Fishing in Area 3 has also been a closed to line fishing since 1998 (Newman et al., 2015b). **Licences/vessels**: 11 permits in the PFTIMF, six licences in PTMF, 2017–2018 season (DPIRD, 2019b). 10 vessels active in 2017–2018 season (2 PFTIMF, 3 PTMF and 5 PLF; Newman et al., 2017)
Pearl Oyster Managed Fishery	×	✓	×	**Description**: The Western Australian Pearl Oyster Fishery lies approximately 7 km from Operational Area 2 and is the only remaining significant wild-stock fishery for pearl oysters in the world (Fletcher et al., 2006). The species targeted is the Indo-Pacific silver-lipped pearl oyster (*Pinctada maxima*), which are collected in shallow coastal waters along the north-west-shelf through the use of divers (restricted to safe diving depths), and are mainly for use in the culture of pearls (Hart et al., 2017). The fishery is separated into four zones. The Pearl Oyster Zone 1 lies within the EMBA, extending from North West Cape (including Exmouth Gulf) (119° 30´ E) to Cape Thouin (118° 20´ E). There are five licences in Zone 1, with fishing recently recommencing after a hiatus of several years (Hart et al., 2015b). The catch effort in 2018–2019 was 614,002 oysters (DPIRD, 2018). **Licences/vessels**: five vessels and 12,845 diver hours in 2017–2018 (DPIRD, 2018).
West Coast Rock Lobster Fishery	×	✓	×	**Description**: The West Coast Rock Lobster Fishery targets the western rock lobster (*Panulirus cygnus*) from Shark Bay south to Cape Leeuwin using baited traps (pots), approximately 8 km from Operational Area 2. In 2008, it was determined that the allocated shares of the West Coast Rock Lobster resource would be 95% for the commercial sector, 5% to the recreational sector, and one tonne to customary fishers. The commercial fishery has been Australia's most valuable single-species wild capture fishery. In 2012–2013, the fishery moved to an individually transferable quota fishery. The fishery is managed using zones, seasons and total allowable catch. The fishing effort is off the central and southern west coast (de Lestang et al., 2018).The catch effort in 2018 was 6400 t (DPIRD, 2018). **Licences/vessels**: 653 licences in 2017–2018 (DPIRD, 2019b). 234 vessels in 2017 (de Lestang et al., 2018).
Gascoyne Demersal	×	✓	×	**Description**: The Gascoyne Demersal Scalefish Fishery (GDSF) comprises commercial and recreational fishing for demersal scalefish in the continental waters of the Gascoyne Coast Bioregion,

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Scalefish Managed Fishery				approximately 162 km from Operational Area 2. The GDSF is located between the southern Ningaloo Coast to south of Shark Bay with a closure area from Point Maud to Tantabiddi. Commercial vessels have historically targeted the oceanic stocks of pink snapper (*Pagrus auratus*) during the winter months, with the main component caught within Shark Bay, accounting for 80% of the total commercial catch. The GDSF continues operating throughout the year targeting additional demersal species including the goldband snapper (*Pristipomoides spp*.), red emperor (*Lutjanus sebae*), emperors and cod (family Serranidae) (Jackson et al., 2015). The catch effort in 2019 was 45.1 t of snapper, and 164 t of other demersals (DPIRD, 2019b). **Licences/vessels**: 58 licences in 2017–2018 (DPIRD, 2019b). 16 vessels (Jackson et al., 2018; Gaughan and Santoro, 2018).
Shark Bay Prawn and Scallop Managed Fisheries	×	✓	×	**Description**: The Shark Bay Prawn Managed Fishery lies approximately 214 km from Operational Area 2 and is the highest producing Western Australian fishery for prawns. It targets the western king prawn (*Penaeus latisulcatus*) and brown tiger prawn (*Penaeus esculentus*) and takes a variety of smaller prawn species including endeavour prawns (*Metapenaeus spp*.) and coral prawns (various species). In 2018, The Shark Bay Prawn Managed Fishery reported a catch effort of 1608 t (DPIRD, 2018). The Shark Bay Scallop Managed Fishery targets the saucer scallop (*Amusium balloti*) and was usually Western Australia's most productive scallop fishery until it was closed due to the results from the pre-season survey of stock abundance (Sporer et al., 2015). The stock is currently recovering after sustained recruitment (Kangas et al., 2017b). In 2018, the Shark Bay Scallop Managed Fishery reported a catch effort of 1632 t (DPIRD, 2018). **Licences/vessels**: 18 vessels in 2017 (Kangas et al., 2018). 18 (Prawn) and 29 (Scallop) licences in 2019 (DPIRD, 2019b).
West Coast Demersal Scalefish Fishery	×	✓	×	**Description**: The West Coast Demersal Scalefish Fishery lies approximately 507 km from Operational Area 2 and comprises inshore and offshore suites of demersal scalefish species that are exploited by different commercial fisheries, recreational and charter fishers operating in the West Coast Bioregion. The West Coast Inshore Demersal suite occurs in waters <250 m deep and comprises approximately 100 different species, the most important of which are West Australian dhufish (*Glaucosoma hebraicum*) and pink snapper (*Pagrus auratus*). Less important species include redthroat emperor (Lethrinus miniatus), bight redfish (*Centroberyx gerrardi*) and baldchin groper (*Choerodon rubescens*). The West Coast Offshore Demersal suite occurs in waters <250 m deep and includes eightbar groper (*Hyporthodus octofasciatus*), hapuka (*Polyprion oxygeneios*), blue-eye trevalla (*Hyperoglyphe antactica*) and ruby snapper (*Etelis carbunculus*).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				In 2016, the West Coast Demersal Scalefish (interim) Managed Fishery reported a total catch of 353 t (Smith and Grounds, 2018) **Licences/vessels:** commercial not available; 53 charter vessels (Fairclough et al., 2017).
Onslow Prawn Managed Fishery	×	✓	×	**Description**: The Onslow Prawn Managed Fishery encompasses a portion of the continental shelf off the Pilbara; approximately 59 km from Operational Area 2. The fishery targets a range of penaeids (primarily king prawns) which typically inhabit soft sediments <45 m water depth. Fishing is carried out using trawl gear over unconsolidated sediments (sand and mud). The catch was negligible in the 2017-18 season, at <1 t, Only five days of fishing effort was undertaken (by one vessel) in 2017 (Kangas et al., 2017). **Licences/vessels:** 30 licences in 2017–2018 (DPIRD, 2019b). One vessel (Kangas et al., 2018a).
Nickol Bay Prawn Managed Fishery	×	✓	×	**Description:** The Nickol Bay Prawn Managed Fishery is approximately 285 km of Operational Area 2, and targets penaeid prawns (primarily banana prawns) using trawl gear. The target species typically inhabits sandy and muddy substrate in <45 m water depth. The catch effort in 2018–2019 was 81 t (DPIRD, 2018). **Licences/vessels:** 14 licences in 2017–2018 (DPIRD, 2019b). The number of vessels is unreported.
Exmouth Gulf Prawn Managed Fishery	×	✓	×	**Description**: The Exmouth Gulf Managed Fishery targets penaeid prawns (primarily banana prawns) using trawl gear within Exmouth Gulf, approximately 19 km from Operational Area 2. The target species typically inhabits sandy and muddy substrate in <45 m water depth. The catch effort in 2018–2019 was 880 t (DPIRD, 2019b). **Licences/vessels:** 15 licences in 2017–2018 (DPIRD, 2019a); Six vessels in 2015 (Sporer et al., 2015a), not provided in 2017–2018 report.

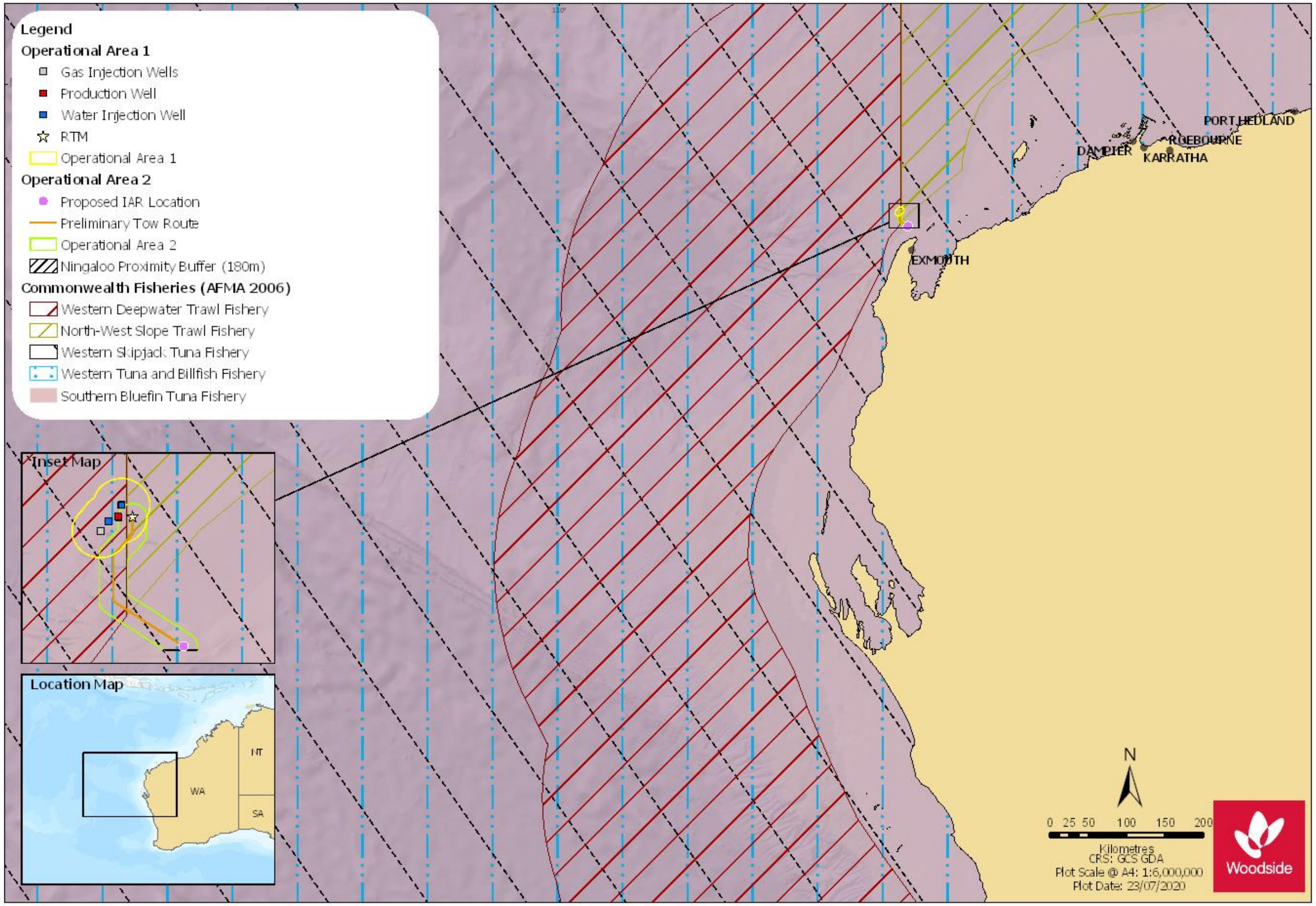


Figure 4-13: Location of Commonwealth fisheries in relation to the Operational Areas

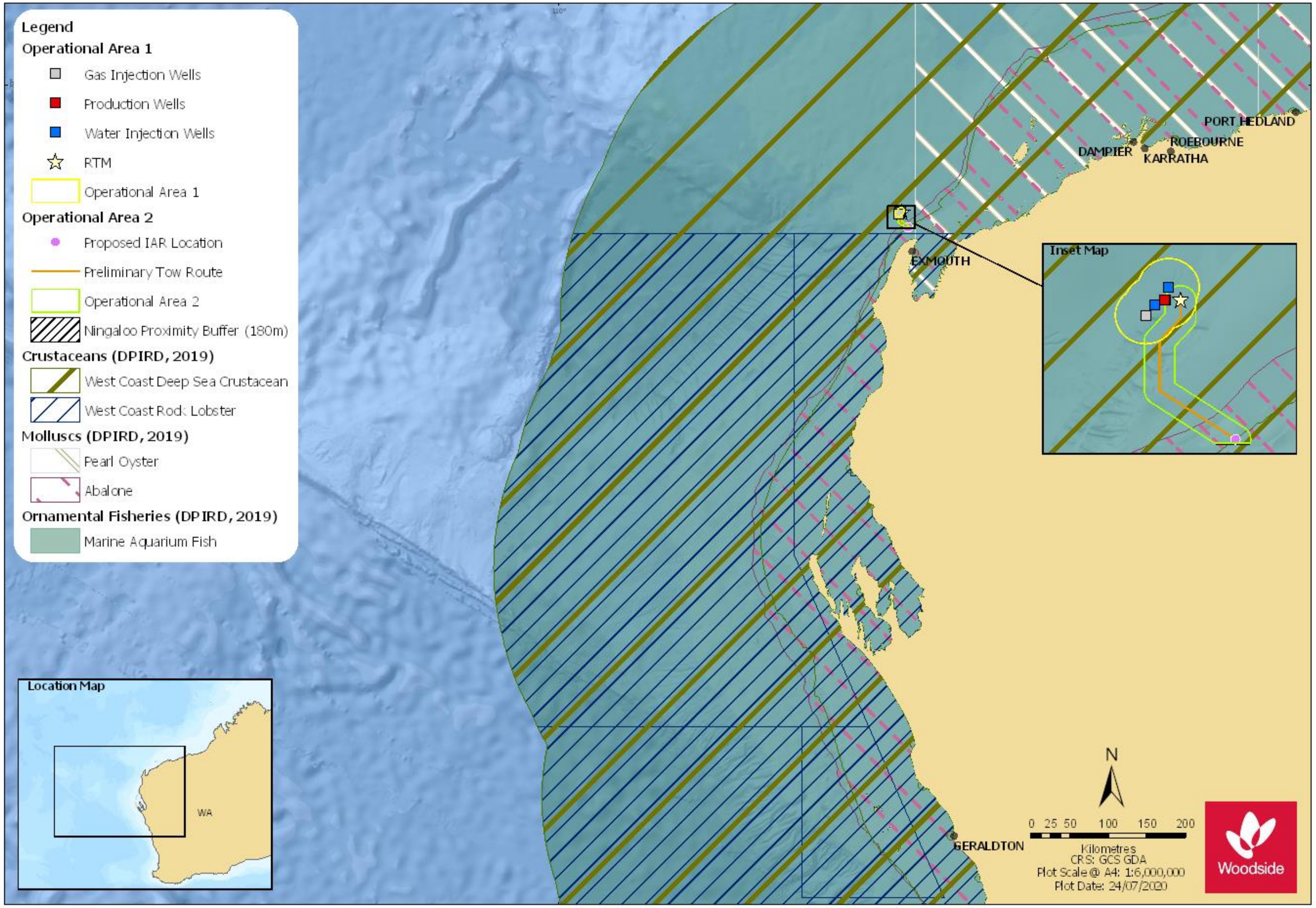


Figure 4-14: Location of State fisheries in relation to the Operational Areas

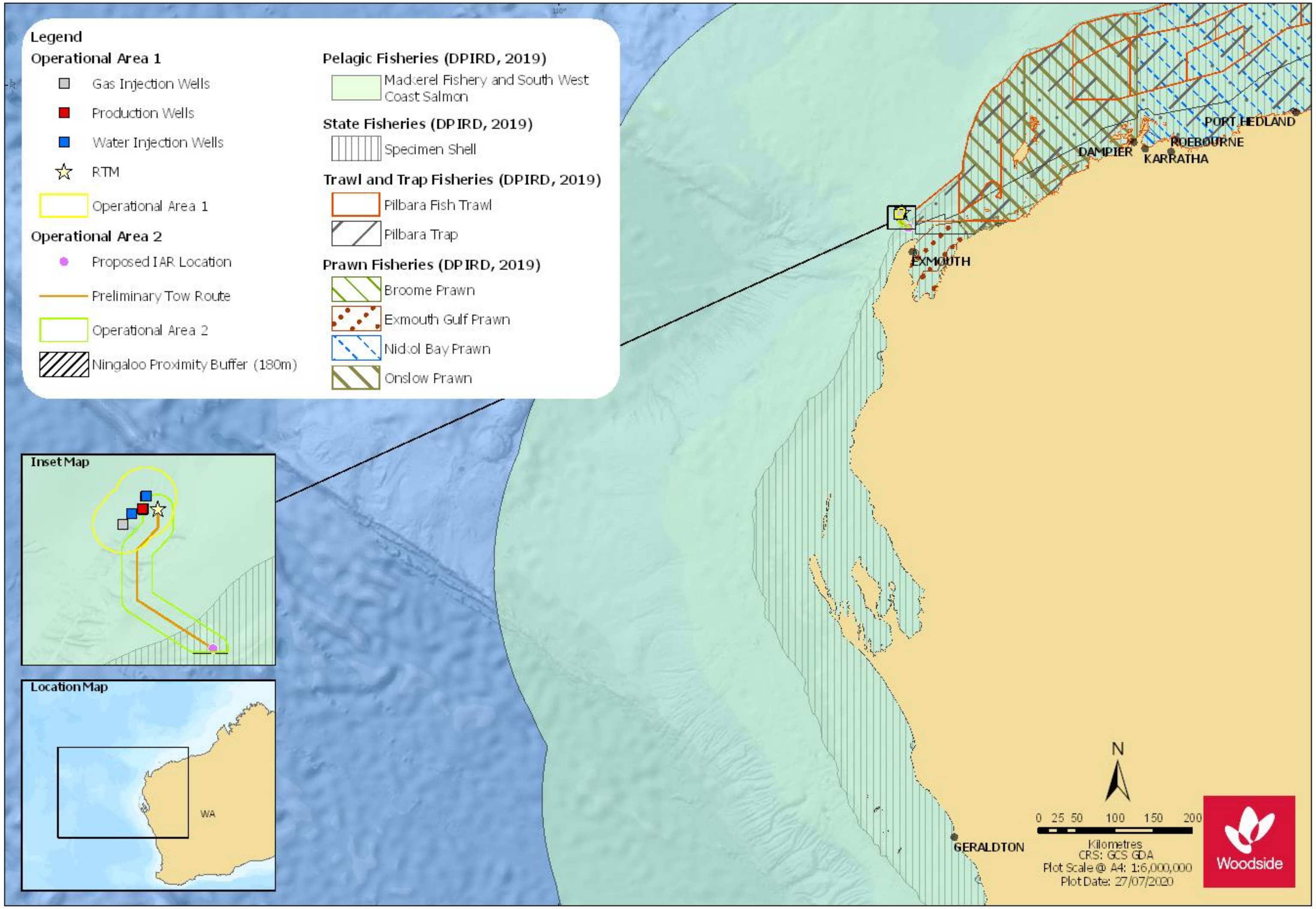


Figure 4-15: Location of State fisheries in relation to the Operational Areas

4.5.3.2 Aquaculture

There are no aquaculture activities within the Operational Areas as these operations are typically restricted to shallow coastal waters. Aquaculture in the region consists primarily of culturing hatchery-reared and wild caught oysters (*Pinctada maxima*) for producing pearls, which is primarily centred around Broome and the Dampier Peninsula (outside the EMBA). Leases typically occur in shallow coastal waters at depths of less than 20 m (Fletcher et al., 2006). There are existing pearl aquaculture leases at the Montebello Islands, within the Flying Foam Passage in the Dampier Archipelago and within Exmouth Gulf (Fletcher et al., 2017), all outside the EMBA. Other types of aquaculture leases are also found near the Montebello Islands, Dampier Archipelago, the Exmouth Gulf and near Onslow, all outside the EMBA.

Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Fletcher et al., 2006).

4.5.4 Fisheries – Traditional

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

4.5.5 Tourism and Recreation

No tourism activities take place specifically within the Operational Areas but it is acknowledged that there are growing tourism and recreational sectors in WA and these sectors have expanded in the area over the last couple of decades.

Due to the Operational Areas' water depths (400–600 m in Operational Area 1 and about 150 m at the proposed location of the IAR) and distance offshore, any existing recreational fishing activity within the Operational Areas is likely to be limited to around the boundary of the Ningaloo AMP (Operational Area 2); however, these activities are generally restricted to about 40 m water depths. Current Fish Cube data indicate up to 3 Charter Operator vessels were active in the waters within or adjacent to the Operational Areas in 2018–2019.

Exmouth is located in the Gascoyne region, which experiences the second highest recreational fishing effort in WA (12%), after the West Coast Bioregion (74%) which covers an area from Geraldton to Busselton (Tate et al., 2020). The Exmouth region hosts various fishing events which generate increases in fishing activities during the year, particularly those associated with more avid fishers such as fishing for pelagic species and fishing in deeper waters.

The Exmouth Game Fishing Club runs three annual fishing competitions that may overlap with Operational Area 2. Indicative dates for these events are:

- Heavy Tackle Tournament – Australia Day weekend (late January; three days of fishing)
- Billfish Bash – held just before GAMEX (three days of fishing)
- GAMEX 2021 – planned to occur 12 to 20 March 2021 (six days of fishing).

A statewide survey of boat-based recreational fishing conducted by Ryan et al. (Fisheries Research Report No. 287) in 2015–2016 summarised recreational fishing trends in WA (**Figure 4-16**). In the Gascoyne Coast Bioregion, 2,331 residents held a recreational fishing from boat licence in 2015. Most fishing occurs between April and August, which coincides with the dry season and peak tourist season. Most fishing occurs in nearshore (<20 m water depth) and inshore demersal habitats (20–250 m depth), with a lower proportion of pelagic (all depths), offshore demersal (depths >250 m), estuarine, and freshwater fishing. The vast majority of boat-based fishing is conducted by line, with lower proportions of net fishing, diving, potting, and other forms of fishing. The Gascoyne also hosts some of the most avid fishers, with almost half of fishers spending more than 20 days fishing per annum, the highest percentage across WA (Ryan et al., 2016).

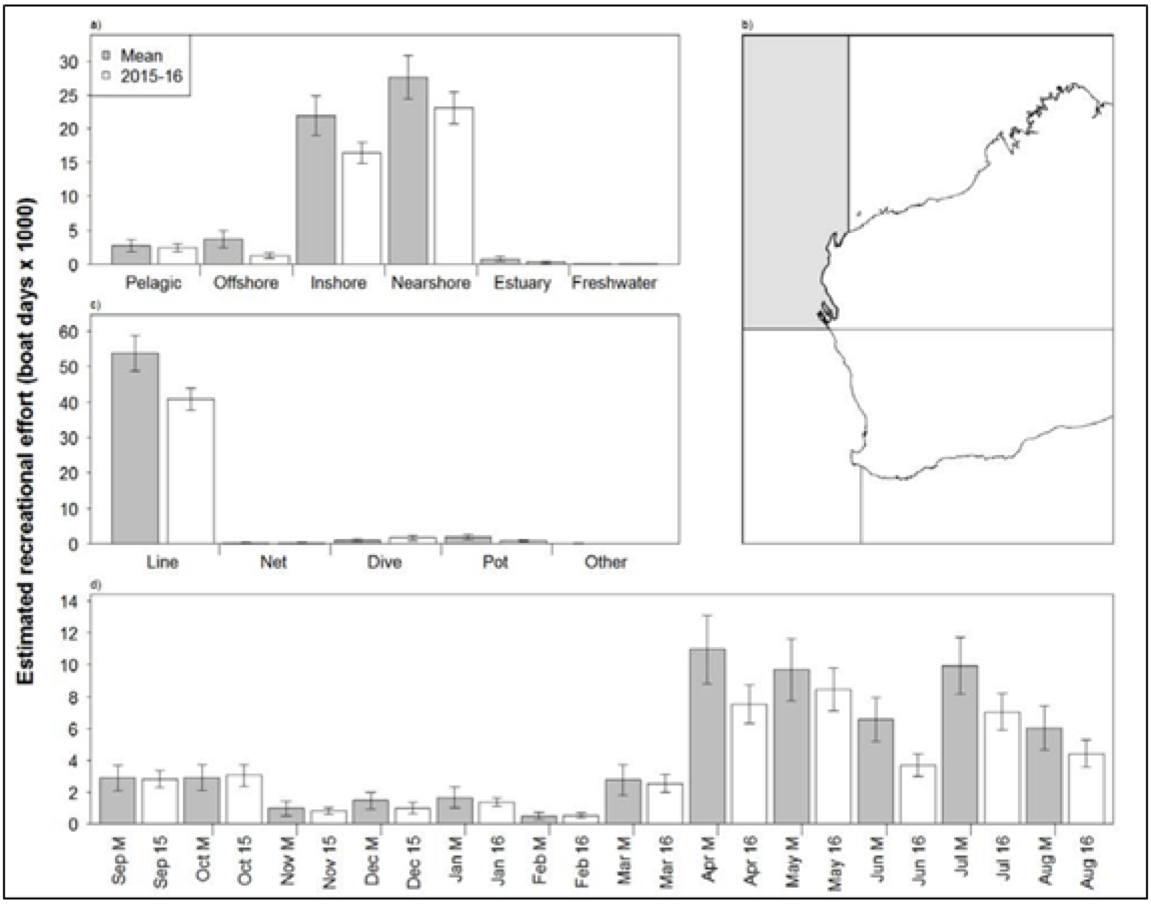


Figure 4-16: Trends in boat-based recreational fishing effort (boat days x 1000) for the Gascoyne Coast Bioregion during 2015–2016 (white bars) compared to mean effort from 2011–2012 and 2013–2014 (grey bars)

a) effort by habitat; b) map of the bioregion; c) effort by fishing method; d) effort by month.

Recreational use of the Ningaloo AMP (about 300 m south of Operational Area 2) varies in intensity throughout the year, depending on school holidays and seasonal peaks of marine fauna being observed. Marine nature-based tourism attracts about 102,000 annual visitors to the Exmouth region, with an estimated AU$151 million spent per year by visitors (Tourism Research Australia, 2017).

Within the EMBA, tourism is one of the largest revenue earners of all the major industries of the Gascoyne and Pilbara regions 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 WHP (100 m from Operational Area 2) and North West Cape area, including recreational fishing, snorkelling and scuba diving, whale shark encounters (April to August) and manta rays (September to November), whale watching and encounters (July to October) and turtle watching (all year round) (Schianetz et al., 2009). Within the socio-cultural EMBA, the northern Pilbara beaches provide fishing, swimming and boating opportunities as well as Thevenard Island.

4.5.6 Oil and Gas Infrastructure

The Operational Areas are located within an area of established oil and gas operations in the broader NWMR. **Table 4-11** details other facilities located in proximity to the Operational Areas. Several facilities (platforms and floating production, storage and offloading vessels (FPSOs) and platforms) are currently operating in the vicinity of the Operational Areas (**Figure 4-17** and **Table 4-11**). While the Stybarrow Venture FPSO is no longer on station (11 km from Operational Areas), the subsea infrastructure associated with the development remains in situ.

Table 4-11: Other oil and gas facilities in the vicinity of the Operational Areas

Facility name and operator	Approx. distance from Operational Areas (km)	Direction
Ngujima Yin FPSO (Woodside)	4	North-east
Ningaloo Vision FPSO (Santos)	8	North-east
Pyrenees FPSO (BHP Billiton)	9	South-east

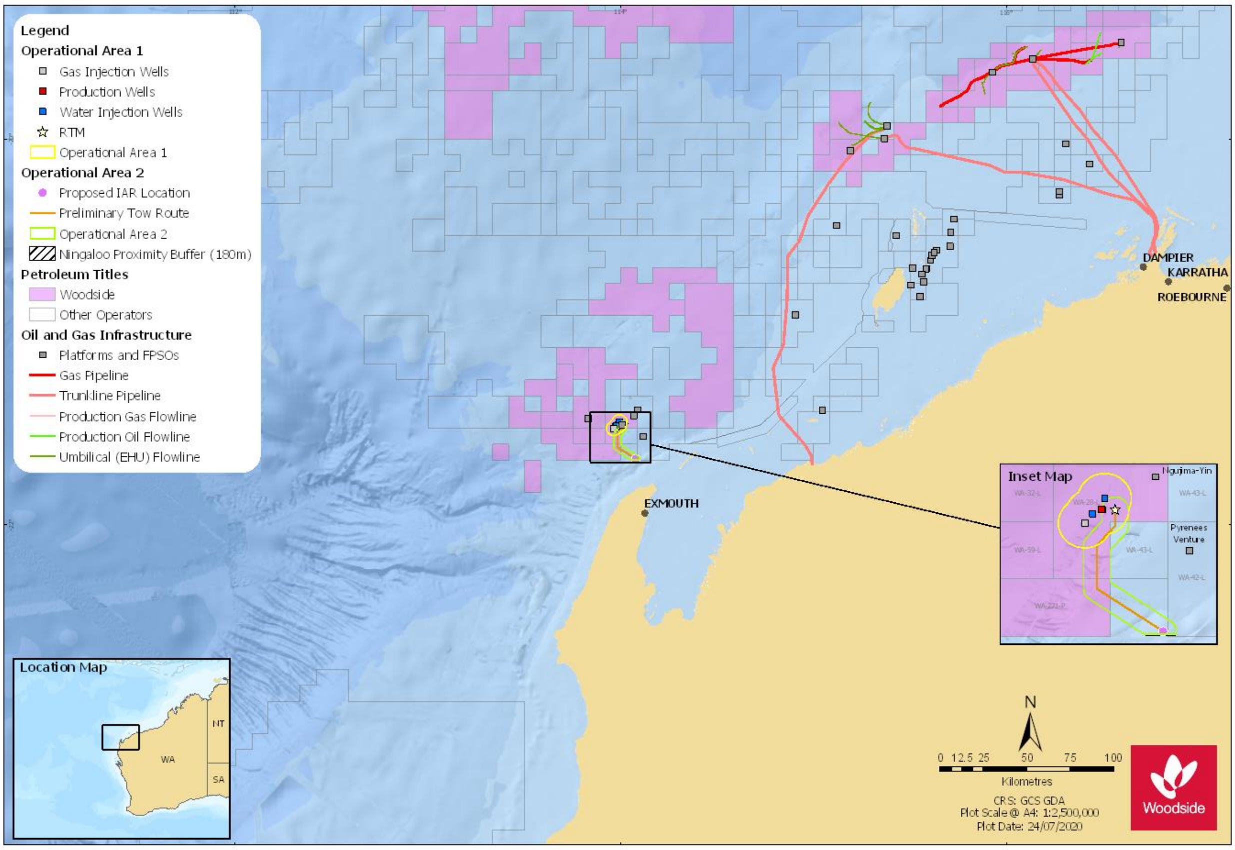


Figure 4-17: Oil and gas Infrastructure with reference to the location of the Operational Areas

4.5.7 Defence

There are designated defence practice areas in the offshore marine waters off Ningaloo and the North West Cape, of which a military flying training area overlaps the Operational Areas (**Figure 4-18**). A Royal Australian Air Force base is located at Learmonth on North West Cape, about 64 km south of Operational Area 2.

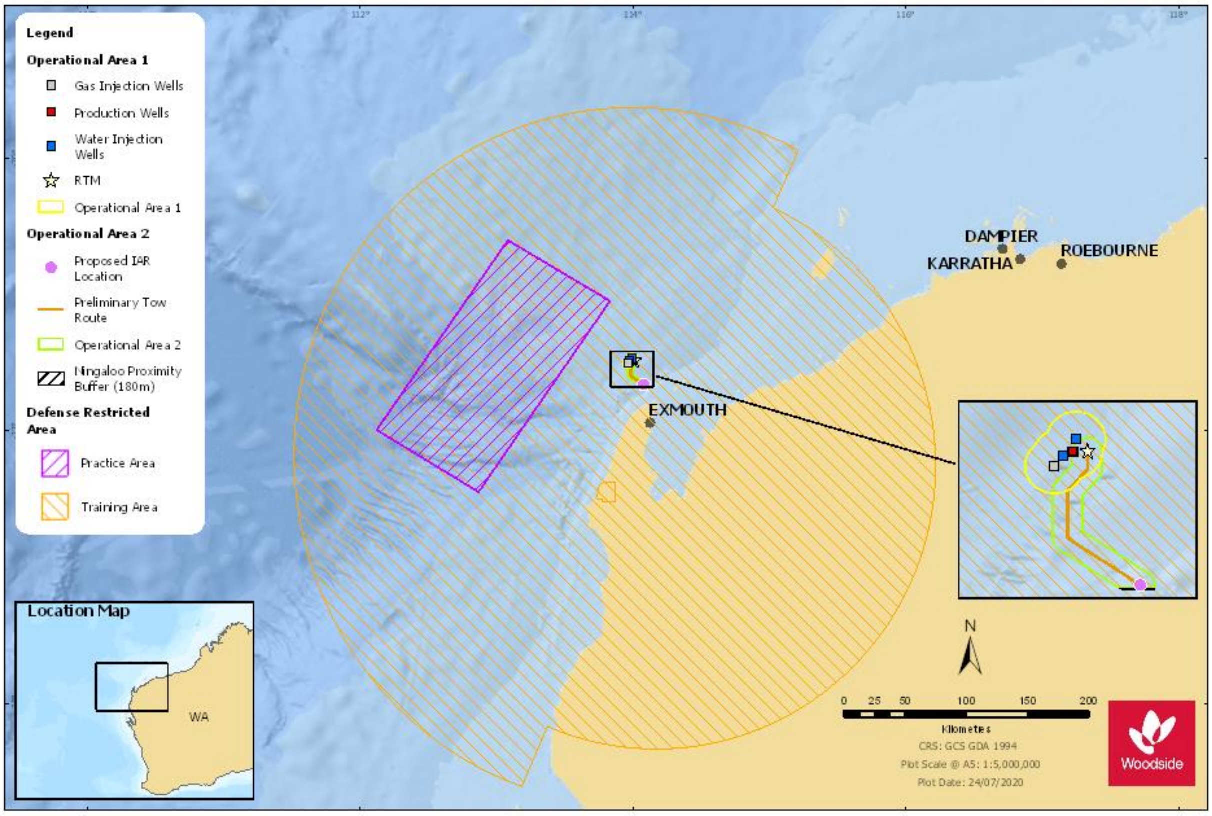


Figure 4-18: Department of Defence demarcated marine offshore areas for military and defence practice with reference to the location of the Operational Areas

4.6 Values and Sensitivities

The values and sensitivities of the Operational Areas and EMBA are presented in this subsection of the existing environment description. The offshore environment of the NWMR contains environmental assets (such as habitat and species) of high value or sensitivity including Commonwealth offshore waters, as well as the wider regional context including coastal waters and habitats such as the Ningaloo World Heritage Area, and the associated resident, temporary or migratory marine life including species such as marine mammals, turtles and birds (**Section 4.4.3**).

Many sensitive receptor locations are protected as part of Commonwealth and State managed areas and have been allocated conservation objectives (International Union for Conservation of Nature (IUCN) Protected Area Category) based on the Australian IUCN reserve management principles in Schedule 8 of the EPBC Regulations 2000. These principles determine what activities are acceptable within a protected area under the EPBC Act. As all planned petroleum activities will take place within the Operational Areas, and no protected areas overlap this, the planned activities associated with the Petroleum Activities Program will be conducted in a manner consistent with the Australian IUCN reserve management principles for the IUCN categories which have been identified in **Table 4-12**.

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

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

The South-west Marine Parks Network Management Plan (Director of National Parks, 2018b) provides the protection and conservation of biodiversity and values of marine parks in the North-west Region that extends from the eastern end of Kangaroo Island in South Australia to the waters off Shark Bay in WA. The South-west Marine Parks Network covers 508,371 km^2 and includes 14 marine parks (Director of National Parks, 2018b).

The South-west Network includes a World Heritage sites, these being the Shark Bay, WA World Heritage Property. The plan also supports a range of uses such as shipping, ports, commercial and recreational fishing, tourism, as well as offshore mining operations.

A number of high value or sensitive environments located within the EMBA are part of the North-west Marine Parks Network and the South-west Marine Parks Network, and management of these is governed by the North-west Marine Parks Network Management Plan and the South-west Marine Parks Network Management Plan (Director of Parks, 2018).

The following section outlines the values and sensitivities of the established and proposed Marine Protected Areas (MPAs) and other sensitive areas in the EMBA (listed in **Table 4-12** and shown in **Figure 4-19**). In addition these areas are also considered in the environmental risk evaluation of planned and unplanned activities associated with the Petroleum Activities Program.

Table 4-12: Summary of established and proposed Marine Protected Areas (MPAs) and other sensitive locations within the EMBA and socio-cultural EMBA

	Distance from Operational Areas to Values/Sensitivity boundaries (km)	IUCN Protected Area Category[1]
Australian Marine Parks (AMP)		
Ningaloo	1 (Operational Area 2)	II, IV
Gascoyne	4 (Operational Area 2)	II, IV, VI
Montebello[2]	144 (Operational Area 2)	VI
Shark Bay	364 (Operational Area 2)	VI
Carnarvon Canyon	325 (Operational Area 2)	IV
Abrolhos	477 (Operational Area 1)	II, IV, VI
Argo-Rowley Terrace[2]	478 (Operational Area 1)	II, VI
State Marine Parks and Nature Reserves		
Marine Parks		
Ningaloo	9 (Operational Area 2)	IA, II, IV
Barrow Island[2]	151 (Operational Area 1)	IA
Montebello Islands[2]	179 (Operational Area 1)	IA
Marine Management Areas		
Muiron Islands	15 (Operational Area 2)	IA, VI
Barrow Island[2]	141 (Operational Area 1)	IA
Fish Habitat Protection Areas		
None identified within the Operational Area of EMBA		
Nature Reserves		
Pilbara Islands – South and Middle Island Groups	59 (Operational Area 2)	IA
Barrow Island[2]	147 (Operational Area 1)	IA

	Distance from Operational Areas to Values/Sensitivity boundaries (km)	IUCN Protected Area Category[1]
Muiron Islands[2]	15 (Operational Area 2)	IA
Boodie, Double, and Middle Islands[2]	145 (Operational Area 1)	IA
Heritage		
WHPs		
Ningaloo	1 (Operational Area 2)	Not applicable
National Heritage Areas		
The Ningaloo Coast	1 (Operational Area 2)	Not applicable
Commonwealth Heritage Areas		
Ningaloo Marine Area – Commonwealth Waters	1 (Operational Area 2)	Not applicable
Key Ecological Features		
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	Overlaps Operational Area	Not applicable
Continental Slope Demersal Fish Communities	Overlaps Operational Area	Not applicable
Commonwealth waters adjacent to Ningaloo Reef	0.3 (Operational Area 2)	Not applicable
Ancient coastline at 125 m depth contour	8 (Operational Area 2)	Not applicable
Exmouth Plateau	70 (Operational Area 1)	Not applicable
Glomar Shoals[2]	329 (Operational Area 1)	Not applicable
Western Demersal Slope and Associated Fish Communities	464 (Operational Area 2)	Not applicable
Wallaby Saddle	488 (Operational Area 2)	Not applicable
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals[2]	648 (Operational Area 1)	Not applicable
Ancient Coastline at 90–120 m Depth	670 (Operational Area 2)	Not applicable
Western Rock Lobster	670 (Operational Area 2)	Not applicable
Commonwealth marine environment surrounding the Houtman Abrolhos Islands	711 (Operational Area 2)	Not applicable
Perth Canyon and adjacent shelf break, and other west coast canyons	695 (Operational Area 2)	Not applicable

*[1]Conservation objectives for IUCN categories in **Table 4-12** include:*

IA: Strict nature reserve – protected from all but light human use

II: National park – protect ecosystems and natural values, but facilitate human visitation

IV: Habitat/species management area – conservation of a particular species, taxonomic group or habitat

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

[2] MPAs only found in the socio-cultural EMBA

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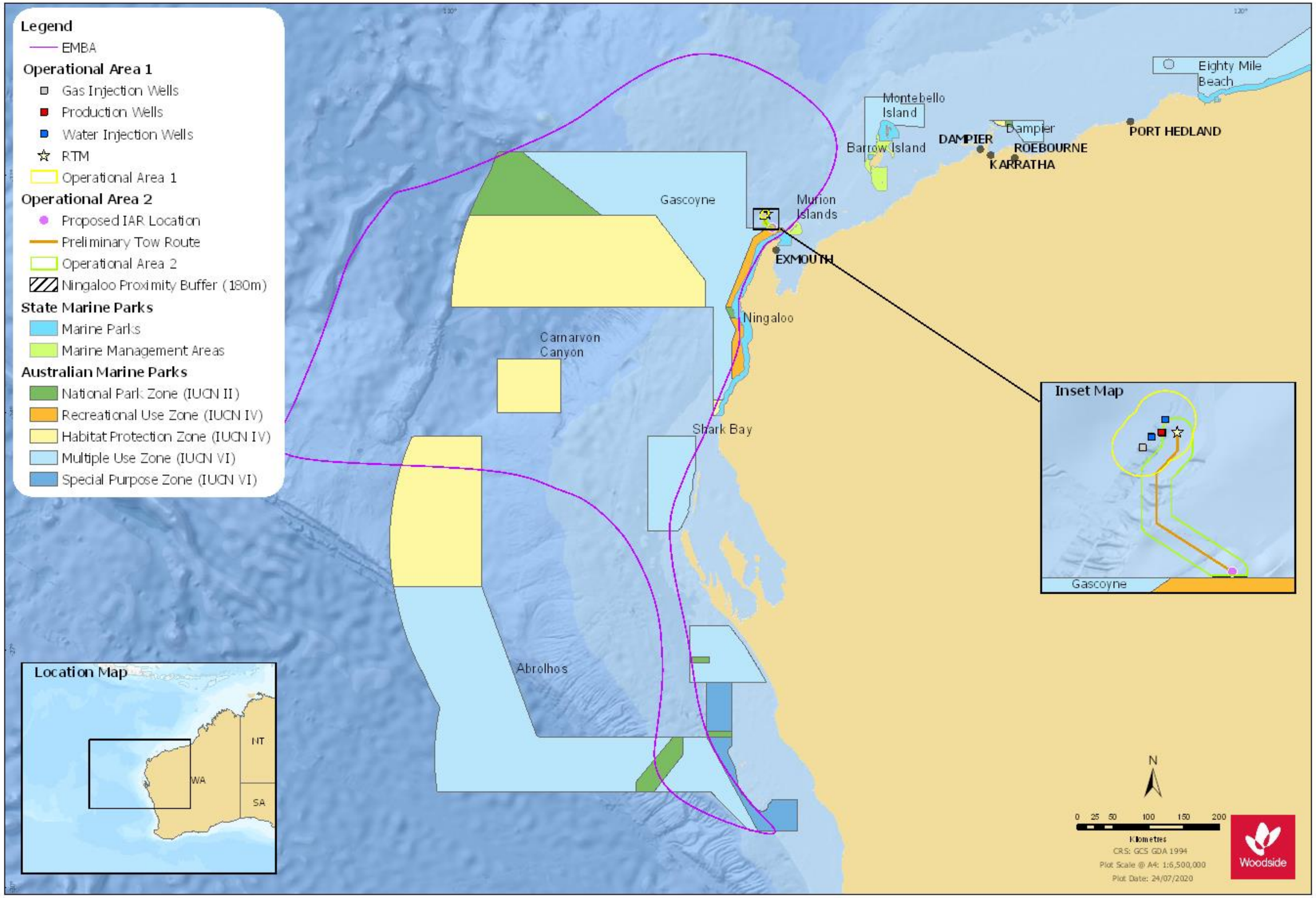

Figure 4-19: Established and proposed Commonwealth and State MPAs in relation to the Operational Areas and EMBA

4.6.1 Pilbara Coast and Islands

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

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

The Northern Island Group includes more than 30 islands that range from east of Cape Preston south to the mouth of the Robe River, 10–35 km offshore, including the Great Sandy Islands Nature Reserve and the Passage Islands. The Northern Island Group is about 144 km east of Operational Area 2.

The Middle Island Group, which is about 116 km east of Operational Area 2, includes the Mary Anne Reefs and neighbouring small islands. The Southern Island Group includes Serrurier, Bessieres, and Thevenard Islands Nature Reserves and is about 60 km east of Operational Area 2. The nearshore habitats of these islands generally consist of fringing reefs on the seaward side and wide intertidal sand flats on the leeward side. Despite generally high turbidity in the area and relatively low abundance, hard coral biodiversity is high (Chevron Australia Pty Ltd 2010). The coral community structure within this area, and others within the region, is highly temporally variable due to cyclonic activity.

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

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

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

4.6.2 Ningaloo Coast and Gascoyne

4.6.2.1 Ningaloo Coast World Heritage Area

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

- Criterion (vii): The landscapes and seascapes are mostly intact and comprise large-scale marine, coastal and terrestrial environments. The lush and colourful underwater scenery provides a stark and spectacular contrast with the arid and rugged land. Large aggregations of whale sharks and important aggregations of other fish species and marine mammals occur in the Ningaloo Coast

WHA. Mass coral spawning and seasonal nutrient upwelling cause a peak in productivity that leads to groups of approximately 300–500 whale sharks, making this the largest documented aggregation in the world.

- Criterion (x): The Ningaloo Reef harbours a high marine diversity of more than 300 documented coral species, over 700 reef fish species, roughly 650 mollusc species, as well as around 600 crustacean species and more than 1000 species of marine algae. The high numbers of 155 sponge species and 25 new species of echinoderms add to the significance of the area. In the transition zone between tropical and temperate waters, the Ningaloo Coast hosts an unusual diversity of marine turtle species with an estimated 10,000 nests along the coast annually.

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

The Ningaloo Coast WHA provides important nesting habitat for four species of marine turtle found in Western Australia. The North West Cape and Muiron Islands are major nesting sites for loggerhead turtles, with approximately 400 and 600 females nesting annually on the Ningaloo Coast (particularly, North West Cape area) and Muiron Islands, respectively (Department of Environmental Protection, 2001). The North West Cape is also a major nesting habitat for hawksbill and green turtles, with an estimated 1000–1500 green turtles nesting in the area annually (Department of Environment and Conservation, 2007). The Muiron Islands are minor nesting sites for flatback and hawksbill turtles (Department of Environment and Conservation, 2007).

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

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

4.6.2.2 Ningaloo AMP

The Ningaloo AMP covers 2326 km^2 and is approximately 1200 km north of Perth. It is contiguous with the Western Australian Ningaloo Marine Park. The Ningaloo reef, which lies in State waters within the State-managed Marine Park, is further protected by the Ningaloo AMP. Water depths range from shallow water of 30 m depth to oceanic waters at 1000 m deep. Major natural values of the reserve include (DoEE n.d.):

- three KEFs (**Section 4.6.7**):
  - canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula
  - Commonwealth Waters adjacent to Ningaloo Reef
  - continental slope demersal fish communities.
- foraging areas adjacent to important breeding areas for migratory seabirds, whale sharks and marine turtles
- important nesting sites for marine turtles
- part of the migratory pathway of the humpback whale

- shallow shelf environments with depths ranging from 15 to 150 m, providing protection for the shelf and slope habitats, as well as pinnacle and terrace sea-floor features
- examples of the seafloor habitats and communities of the central western shelf transition.

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

The Ningaloo AMP (Commonwealth Waters) Management Plan outlines objectives for retaining the values of this protected area and any potential or confirmed threats which could impact these values. Values which could be impacted from the Petroleum Activities Program and the associated management objectives (goals and strategies) in the Management Plan are outlined in **Table 4-13**. Note each management objective in the plan relates only to a source of risk, rather than the value potentially impacted, and is therefore generic for all Petroleum Activities.

Table 4-13: Relevant key threats and management objectives from the Ningaloo AMP (Commonwealth Waters) Management Plan

Value potentially impacted by Petroleum Activities Program	Relevant existing and potential threats identified in Management Plan	Associated management objectives (strategies/goals)	Relevant EP section
Physical values			
High water quality	Pollution: • contaminants and marine debris arising from petroleum or mineral exploration and production • oil/chemical spill from shipping accident.	Management goal – to prevent adverse impacts on the physical, ecological, social and cultural values of the Commonwealth Waters from petroleum or mining activities in the vicinity of Ningaloo AMP. Management strategies – maintain the exclusion of petroleum and mineral exploration and production from Commonwealth Waters.	Credible risks and impacts to these receptors are considered in **Section 6.6.2**
Ecological values			
High water quality	• Petroleum or mineral exploration and production activities including seismic operations • Pollution (see above).	Management goal – to prevent adverse impacts on the physical, ecological, social and cultural values of the Commonwealth Waters from petroleum or mining activities in the vicinity of Ningaloo AMP. Management strategies – maintain the exclusion of petroleum and mineral exploration and production from Commonwealth Waters.	Credible risks and impacts to these receptors are considered in **Section 6.6.2**
Marine mammals and fish (e.g. whales; dugong; whale sharks)	Oil/chemical spill		
Marine reptiles (e.g. turtles)	Oil/chemical spill		
Sea birds	Oil/chemical spill		
Social values			
• Major destination for recreational fishers • Recreational boating and yachting • Destination for nature based tourism (e.g. diving/fishing, whale shark/marine life	Reduced amenity resulting from major oil/chemical spill.	Management goal – to prevent adverse impacts on the physical, ecological, social and cultural values of the Commonwealth Waters from petroleum or mining activities in the vicinity of Ningaloo AMP. Management strategies – maintain the exclusion of petroleum and	Credible risks and impacts to these receptors are considered in **Section 6.6.2**

Value potentially impacted by Petroleum Activities Program	Relevant existing and potential threats identified in Management Plan	Associated management objectives (strategies/goals)	Relevant EP section
viewing/interaction tours).		mineral exploration and production from Commonwealth Waters.	

4.6.2.3 Ningaloo Marine Park and Muiron Islands Marine Management Plan

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

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

- unique geomorphology, which has resulted in a high habitat and species diversity
- high sediment and water quality
- subtidal and intertidal coral reef communities providing food, settlement substrate and shelter for marine flora and fauna
- filter feeding communities (sponge gardens) in the northern part of the North West Cape and the Muiron and Sunday islands
- shoreline intertidal reef communities providing feeding habitat for larger fish and other marine animals during high tide
- soft sediment communities found in deeper waters, characterised by a surface film of microorganisms that provide a rich source of food for invertebrates
- macroalgae and seagrass communities, which are an important primary producer providing habitat for vertebrate and invertebrate fauna
- mangrove communities which occur only in the northern part of the Ningaloo Marine Park and are important for reef fish communities (Cassata and Collins, 2008) and support a high diversity of infauna, particularly, molluscs (600 mollusc species)
- diverse fish fauna (approximately 460 species)
- foreshores and nearshore reefs of the Ningaloo coast and Muiron/Sunday islands which provide internesting, nesting and hatchling habitat for several species of marine turtles including the loggerhead, green, flatback and hawksbill turtles
- whale sharks which aggregate annually to feed in the waters around Ningaloo reef, from March to July, with the largest numbers being recorded around April and May (Sleeman et al., 2010). The season can be variable, with individual whale sharks being recorded at other times of the year. Timing of the whale sharks' migration to and from Ningaloo coincides with the mass coral spawning period when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo reef
- seasonal shark aggregations and manta rays which are commonly found in the area with a permanent population of manta rays (*manta alfredi*) inhabiting the Ningaloo reef. Numbers are boosted periodically by roaming and seasonal animals. Small aggregations coincide with small pulses of target prey and the spawning events of many reef inhabitants, whilst larger aggregations coincide with major seasonal spawning events. The number of species in the

Ningaloo reef area peaks during autumn, which corresponds to coral spawning, and during spring which corresponds with the crab spawning event (McGregor n.d.)

- annual mass coral spawning on Ningaloo reef. Synchronous, multi-specific spawning of tropical reef corals occurs during a brief predictable period in late summer/early autumn generally seven to nine nights after a full moon on neap, nocturnal ebb tides March-April each year (Rosser and Gilmour, 2008; Taylor and Pearce, 1999)
- large coral slicks which generally form over shallow reef areas in calm conditions. It is noted that there are minor spawning activities on the same nights after the February and April full moons and in some years the mass spawning event occurs after the April full moon (Simpson et al., 1993)
- marine mammals such as dugong and small cetacean populations that frequent or reside in nearshore waters. Dugong numbers in Ningaloo Marine Park are considered to be in the order of around 1000 individuals, with a similar number in Exmouth gulf (CALM, 2005). The Ningaloo/Exmouth gulf region supports a significant population of dugongs which is interconnected with the Shark Bay resident population (which represents less than 10% of the world's dugongs)
- nesting and foraging habitat for seabirds and shorebirds. Approximately 33 species of seabirds are recorded in the Ningaloo Marine Park (13 resident and 20 migratory), with five known rookeries as well isolated rookeries on the Muiron and Sunday islands.

In addition to the ecological and conservation values, the Ningaloo Marine Park has a number of social values including culture heritage (**Section 4.5.1**) and marine-based tourism and recreation (water-sports and fishing) (**Section 4.5.5**). The Ningaloo Marine Park (State waters) is contiguous with the Ningaloo Australian Marine Park (**Figure 4-19**) and The Ningaloo Coast was listed as a National Heritage Place, 6 January 2010 due to its extraordinary natural qualities and Indigenous Significance (DoEE, 2019).

Ningaloo Shoreline, Shallow Subtidal Reef, and Intertidal Habitats

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

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

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

- outer reef flat (very shallow, <1 m depth) at the back of the reef crest: coralline algae/coral community (spur and groove). Similar morphology to the reef slope
- rocky middle/inner reef flat (approximately 1 m depth): tabular *Acropora* spp. community
- Back reef lagoon (>2 m depth): patchy staghorn, massive and sub-massive coral community
- lagoonal sand flat (1–2 m depth): sparse corals and algae community. This habitat is characterised by sheltered areas of limestone pavement with a veneer of sand and small

outcrops of corals (*Porites* spp., *Acropora* spp.) With scattered patches of macroalgae (*Sargassum* spp., *Halimeda* spp., *Caulerpa* spp.) or seagrass (*Halophila* spp.)

- lagoonal and inter-reef sandy depressions (3–15 m depth): coral 'bommies' and algal patch community. A distinctive habitat type composed of sandy depressions either found as large deep regions within the lagoon or small depressions/channels inside the reef flat
- lagoon, shoreward reef channels (shallow): macroalgal community. Fleshy algae colonising subtidal limestone pavement that is covered in sand with *Sargassum* spp. Up to 0.5 m high and other red and green algal species. There are also small patches of hard and soft corals, sponges and ascidians
- sublittoral limestone platform: turf algae/mollusc/echinoderm community. This habitat is composed of a flat limestone pavement often contiguous with the rocky shoreline, and supports intertidal and subtidal fauna comprising molluscs (limpets, chitons, small mussels, cowries and giant clams) and echinoderms (sea cucumbers, starfish and sea urchins) with isolated hard and soft coral colonies. The limestone pavement also has a ubiquitous coverage of turf algae
- mangroves: although not a common habitat type within Ningaloo Marine Park, there are mangrove stands in the upper intertidal zone on a muddy substrate of carbonate silt. The mangrove communities are located within the mangrove sanctuary zone (where they occupy a large section of coast between low point and mangrove bay) and sporadically within the osprey sanctuary zone on the Yardie creek banks. There are three species of mangrove: *Avicennia marina*, *Rhizophora stylosa* and *Bruguiera exaristata*. *A. Marina* is most common and widespread. This habitat supports a diverse community of invertebrate fauna including gastropods, crabs and burrowing worms and is also a nursery area for the juveniles of many species of reef fish
- intertidal mud flats: mud flats occur in the lower intertidal zone of the lagoon, formed from the deposition of mud in the sheltered tidal water salt marshes: the salt marsh habitat is seaward of the mangroves and is represented by salt tolerant vegetation and sandy patches.

In addition to the ecological and conservation values, the Ningaloo Marine Park has a number of social values including cultural heritage (both Aboriginal and maritime; **Section 4.5.1**) and marine-based tourism and recreation (water-sports and fishing; **Section 4.5.5**). The Ningaloo Marine Park (State waters) is contiguous with the Ningaloo AMP (Commonwealth Waters).

The Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area outlines objectives for retaining the values of this protected area and any potential or existing threats which could impact these values. Values which could be impacted from the Petroleum Activities Program and the associated management objectives outlined in the Management Plan are detailed in **Table 4-14**.

Table 4-14: Relevant key threats and management objectives from the Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area

Value potentially impacted by Petroleum Activities Program	Relevant existing and potential threats identified in Management Plan	Associated management objectives	Relevant EP section
Ecological values			
Water quality	No explicit threats from hydrocarbon spill, i.e.: • toxicant inputs from the accidental spillage of fuel and oils • hydrocarbon spills from passing ships	To ensure that the water quality of the reserves is maintained at a level which supports and maintains the area's ecological and social values.	Credible risks and impacts to these receptors are considered in **Section 6.6.2**.

Value potentially impacted by Petroleum Activities Program	Relevant existing and potential threats identified in Management Plan	Associated management objectives	Relevant EP section
Coral reef communities	Pollution events (shipping, oil/gas industry)	To ensure the diversity and abundance of coral reef communities in the reserves are not significantly impacted by human activities within the reserves.	
Shoreline and intertidal communities	Pollution events (shipping, oil/gas industry)	To ensure the diversity and abundance of shoreline intertidal reef communities in the reserves are not significantly impacted by trampling and recreational collecting within the reserves.	
Macroalgal and seagrass communities	Pollution events (shipping, oil/gas industry)	To ensure seagrass and macroalgal communities are not disturbed as a result of human activities in the reserves.	
Mangrove communities	Pollution events (shipping, oil/gas industry)	To ensure the species diversity and abundance of mangrove communities within the Park are not significantly impacted by trampling.	
Seabirds, shorebirds and migratory waders	Pollution events (shipping, oil/gas industry)	To ensure the species diversity and abundance of seabird, shorebird and migratory bird species in the reserves are not significantly impacted by human activity.	
Social values			
• Major destination for recreational fishers • Recreational boating and yachting • Destination for nature based tourism (e.g. diving, fishing, whale shark/ marine life viewing/ interaction tours)	Reduced amenity resulting from major oil/chemical spill	Management goal – to prevent adverse impacts on the physical, ecological, social and cultural values of the Commonwealth Waters from petroleum or mining activities in the vicinity of Ningaloo AMP. Management strategies – maintain the exclusion of petroleum and mineral exploration and production from Commonwealth Waters.	Credible risks and impacts to these receptors are considered in **Section 6.6.2**.

Muiron Islands: Shallow Subtidal, Intertidal, and Shoreline Habitats

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

4.6.2.4 Gascoyne AMP

The Gascoyne AMP covers approximately 81,766 km^2 and includes waters from less than 15 m depth to 6000 m depth. Natural values identified within the reserve include (DoEE n.d., Director of National Parks 2018a):

- foraging areas for migratory seabirds (including the wedge-tailed shearwater), hawksbill and flatback turtles and whale sharks
- a continuous connectivity corridor from 15 to over 5000 m
- seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise
- sponge gardens in the south of the reserve adjacent to Western Australian coastal waters
- examples of the ecosystems of the Central Western Shelf Transition, the Central Western transition and the Northwest Province provincial bioregions as well as the Ningaloo mesoscale bioregion.

The park contains three key natural values for the region:

- canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula (associated enhanced productivity, aggregations of marine life and unique sea-floor feature)
- Exmouth Plateau (unique seafloor feature associated with internal wave generation)
- continental slope demersal fish communities (high species diversity and endemism which is the most diverse slope bioregion in Australia with over 500 species recorded of which 76 are endemic to the area).

The park boundary is adjacent to the existing Commonwealth portion of the Ningaloo marine protected area.

4.6.2.5 Carnarvon Canyon AMP

The Carnarvon Canyon AMP lies about 325 km from Operational Area 2, partially within the EMBA. The AMP covers 6177 km² and includes water depths in the range of 1500–6000 m (Director of National Parks, 2018a). The reserve contains a number of natural values, including (Director of National Parks, 2018a):

- deepwater ecosystems associated with the Carnarvon Canyon, a single-channel canyon covering the entire depth range of the canyon
- examples of ecosystems representative of the Central Western Transition
- support for a range of species protected under the EPBC Act, however species' use of the Marine Park is not well understood.

4.6.3 Montebello/Barrow/Lowendal Islands

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

4.6.3.1 Montebello AMP

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

- habitats, species and ecological communities associated with the NWS Province
- BIAs for a range of MNES, include breeding habitat for seabirds and foraging habitat for whale sharks (**Section 4.4.3**)
- two historic shipwrecks, the Trial and the Tanami (both over 100 km from the Operational Areas)

- diverse social values including tourism, fishing, mining and recreation
- foraging areas adjacent to important nesting sites for marine turtles
- part of the migratory pathway of the protected humpback whale
- shallow shelf environments with depths ranging from 15 to 150 m, providing protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features
- examples of the seafloor habitats and communities of the NWS Province bioregion as well as the Pilbara (offshore) mesoscale bioregion (Heap et al., 2005)
- one KEF for the region, the Ancient Coastline at 125 m Depth Contour (**Section 4.6.7**).

The entire Montebello AMP, an area of 341,300 ha, is designated a multiple use zone (IUCN Category IV), allowing for long-term protection and maintenance of the AMP in conjunction with sustainable use, including oil and gas exploration activities. The Montebello AMP is 150 km to the Operational Areas.

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

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

Tourism, commercial fishing, mining and recreation are important activities in the Marine Park (Director of National Parks, 2018).

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

The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are jointly managed and cover a combined area of 1770 km^2, located approximately 141 km from the Operational Areas at the closest point. A sanctuary zone covers the entire 4100 ha Barrow Island Marine Park. The Barrow Island Marine Management Area covers 114,500 ha and includes most of the waters surrounding Barrow Island and Lowendal Islands, except for the port areas around Barrow and Varanus Islands. Key conservation and environmental values within the reserves include (Department of Environment and Conservation 2007):

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

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

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

4.6.3.3 Barrow Island Nature Reserve

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

The Barrow Island coastline consists of dry creek beds, beaches, clay and salt flats, mangroves, intertidal flats and reefs and is bordered by high cliffs on the western side. Key conservation values within the reserves include (DPaW, 2015):

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

4.6.4 Shark Bay

4.6.4.1 Shark Bay World Heritage Area

The Shark Bay WHA includes Bernier Island, Dorre Island and Dirk Hartog’s landing site. Shark Bay was inscribed under all four natural criteria (criterion vii, viii, ix, and x) by the World Heritage

Committee onto the World Heritage Register in 1991. The statement of Outstanding Universal Value for the Shark Bay WHA was based on natural criteria and recognised the following:

- stromatolites, in the hypersaline Hamelin Pool, which represent the oldest form of life on earth and are comparable to living fossils
- one of the few marine areas in the world dominated by carbonates not associated with reef building corals
- one of the largest seagrass meadows in the world, covering 103,000 ha, with the most seagrass species recorded in one area
- marine fauna such as dugong, dolphins, sharks, rays, turtles, fish, and migratory seabirds which occur in great numbers
- the hydrologic structure of Shark Bay, altered by the formation of the Faure Sill and a high evaporation, has produced a basin where marine waters are hypersaline (almost twice that of seawater) and contributed to extensive beaches consisting entirely of shells
- the Wooramel Seagrass Bank is also of great geological interest due to the extensive deposit of limestone sands associated with the bank, formed by the precipitation of calcium carbonate from hypersaline waters
- Shark Bay provides outstanding examples of processes of biological and geomorphic evolution taking place in a largely unmodified environment
- one of the exceptional features of Shark Bay is the steep gradient in salinities, creating three biotic zones that have a marked effect on the distribution and abundance of marine organisms
- Shark Bay is a refuge for many globally threatened species of plants and animals
- the property contains either the only or major populations of five globally threatened mammals, including the burrowing bettong (now classified as Near Threatened), Rufous hare wallaby, banded hare wallaby, the Shark Bay mouse and the western barred bandicoot
- significant population of dugongs, considered to represent up to 10% of the global population, they utilise seagrass habitats for foraging and nursing year round and breed during the summer months
- breeding habitat for 14 species of seabirds, and more than 50 other seabirds passing through the area
- major loggerhead turtle nesting site on Dirk Hartog Island
- minor nesting area on islands for green turtles
- habitat for whale sharks and manta rays
- important staging and socialising locations for humpback whales during their annual migration
- large population of resident Indo-Pacific bottlenose dolphins estimated to number between 2000 and 3000 individuals (Preen et al., 1997)
- the Shark Bay WHA lies outside but just in the vicinity of the EMBA, 340 km south of the Operational Areas.

4.6.4.2 Shark Bay AMP

The Shark Bay AMP covers approximately 7443 km^2, and includes waters in the depth range of approximately 15–220 m (DoEE n.d.). The marine park encompasses offshore waters that buffer the state waters of Shark Bay and the barrier islands of Dirk Hartog, Dorre and Bernier. The park contains a number of natural values (as listed below) and social values relating to marine nature-based tourism and recreation (water-sports and fishing) (**Section 4.5.5**), including (Director of National Parks, 2018a):

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

4.6.5 West Coast and Islands

4.6.5.1 Abrolhos AMP

The Abrolhos Australian Marine Park lies approximately 475 km from the Operational Areas and partially within the EMBA (Habitat Protection Zone), and within the socio-cultural EMBA (Marine National Park Zone, Multiple Use Zone and Special Purpose Zone). The AMP covers a large offshore area of adjacent to the Abrolhos Islands, extending from the State water boundary to the edge of the exclusive economic zone. The marine park covers 88,060 km² and includes waters in the depth range of about 15–6000 m (Director of National Parks, 2018a). The reserve contains a number of natural values, including (Director of National Parks, 2018a):

- part of the migratory pathway for the protected humpback whale and pygmy blue whale
- foraging habitat for Australian sea lions and white sharks
- foraging and breeding habitat for several species of seabirds
- examples of ecosystems representative of the Central Western Province, Central Western Shelf Province, Central Western Transition, and South-west Shelf Transition
- seven KEFs, including the 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, western rock lobster, ancient coastline between 90 and 120 m depth, and the Wallaby Saddle.

4.6.5.2 Houtman Abrolhos Island Nature Reserve

The Houtman Abrolhos Islands is a series of islands and reefs located at the edge of the continental shelf between 28° 15’ S and 29° 00’ S, approximately 735 km offshore from the Operational Areas, comprising three major island groups:

- North Island-Wallabi Group
- Easter Group
- Pelsaert (or Southern) Group.

The islands support a diverse and unique range of marine and terrestrial flora and fauna (DoF, 2012). A number of important historical shipwrecks are located within the island area, with historic sites located on the islands themselves. The key natural values (DoF, 2012) comprise:

- high water quality which is important for maintaining marine ecosystem health and function

- waters comprising a diverse range of marine habitats, home to tropical and temperate species, including Australian sea lions, western rock lobsters and a number of other species currently listed under State and Commonwealth legislation
- a variety of terrestrial plant species and communities, which are utilised by a diverse range of fauna, including birds, some of them unique to the Abrolhos. Many of these species are listed under State and Commonwealth legislation and international agreements
- a wide array of fish and invertebrate species including dhufish, coral trout, pink snapper, baldchin groper, red throat emperor, western rock lobster and saucer scallops, making it a priority target area for commercial, recreational and charter fishing in the Midwest region
- numerous aquaculture licences have been granted for the production of various pearl oyster species, finfish, western rock oysters, corals and sponges at the Abrolhos. There is increasing interest at the Abrolhos for aquaculture of these and other marine species
- unique history including the *Batavia* (National Heritage Listed site) and subsequent shipwrecks, evidence of guano mining and commercial fishing all contribute to the heritage values
- important socio-economically for the region due to tourism and recreation with a high number of visitors. Activities include boating, fishing, diving, wildlife and heritage photography and appreciation
- features including canyons, demersal slope fish communities and meso-scale eddies.

4.6.6 Rowley Shoals

4.6.6.1 Argo-Rowley Terrace AMP

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

The ecological and conservation values include (DoEE, n.d.; Director of National Parks, 2018):

- important foraging areas for migratory seabirds and, reportedly, the loggerhead turtle
- support for relatively large populations of sharks (compared with other areas in the region)
- a range of seafloor features such as canyons, continental rise and the terrace, among others
- two KEFs (Section 4.6.7)
  - canyons linking the Argo Abyssal Plain with the Scott Plateau
  - Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals
- connectivity between the reefs of the Rowley Shoals
- linkage of the Argo Abyssal Plain with the Scott Plateau through canyons.

4.6.7 Key Ecological Features

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

KEFs meet one or more of the following criteria:

- a species, group of species, or a community with a regionally important ecological role (e.g. a predator, prey that affects a large biomass or number of other marine species)

- a species, group of species, or a community that is nationally or regionally important for biodiversity
- an area or habitat that is nationally or regionally important for:
  - enhanced or high productivity (such as predictable upwellings—an upwelling occurs when cold nutrient-rich waters from the bottom of the ocean rise to the surface)
  - aggregations of marine life (such as feeding, resting, breeding or nursery areas)
  - biodiversity and endemism (species which only occur in a specific area), or a unique seafloor feature, with known or presumed ecological properties of regional significance.

Three KEFs overlap the Operational Areas, with an additional eight KEFs within or intersecting the EMBA (**Table 4-12** and **Figure 4-20**).

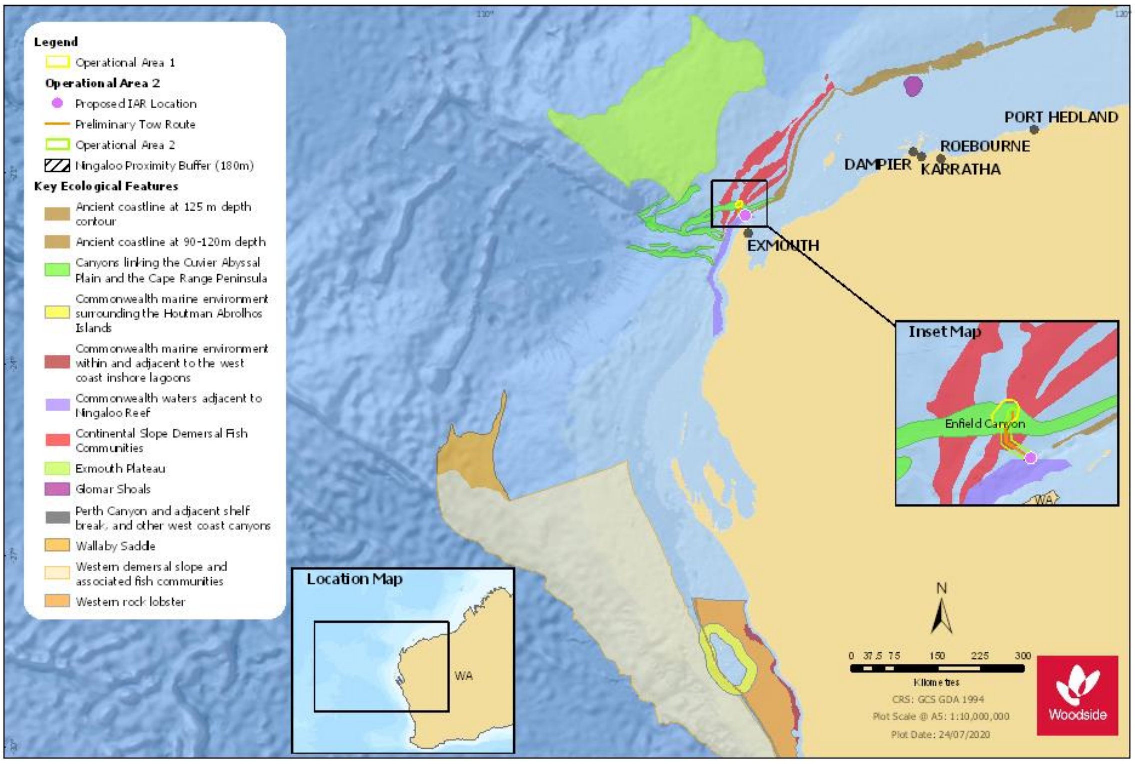

Figure 4-20: KEFs in relation to the Operational Areas

4.6.7.1 Key Ecological Features Within the Operational Areas

Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula

The canyons linking the Cuvier Abyssal Plain with the Cape Range Peninsula KEF (the Canyons KEF) lie off the north-west coast of Australia, overlapping the Operational Areas.

The canyons associated with the Canyons KEF are believed to support the productivity and species richness of Ningaloo Reef (DSEWPaC, 2012a). 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 fish and seabirds are known to occur in the area due to the enhanced productivity (Sleeman et al., 2007). Note that such upwelling may not result from the presence of the canyons, but from other factors such as local wind stress (e.g. upwelling off the Capes region in south-western I) and internal waves (Taylor and Pearce, 1999; Woo et al., 2006).

The Canyons KEF are considered to be 'blind' canyons (i.e. confined to the continental slope with heads that terminate below the continental shelf). Such canyons are thought to have formed during slumping of deposited sediments downwards along the continental slope, rather than as the result of drowned river valleys during Holocene sea level changes (BMT Oceanica, 2016).

Woodside commissioned a literature review of the Cape Range canyon, supported by an environmental survey of the Enfield canyon, which is a tributary of the Cape Range canyon (**Figure 4-7**). The Cape Range canyon is one of the northernmost of a series of canyons on the North and South sections of the Enfield Canyon, on the continental slope of the Ningaloo coast. This survey examined several sections of the canyons and sampled a range of physical and biological parameters, including water, sediments, epifauna and mobile invertebrates, infauna and fish assemblages. Benthic habitats within and surrounding the canyons surveyed were similar in nature to those observed elsewhere in the deep-water NWMR and were characterised by flat unconsolidated sediments composed of sand- and mud-sized particles (BMT Oceanica, 2016; Falkner et al., 2009). Epifauna and mobile invertebrate communities associated with these habitats were considered to be similar to those observed elsewhere in the region, as well as other continental slopes in the Indo-Pacific region (BMT Oceanica, 2016; Heyward and Rees, 2001). The fish assemblages associated with the canyon observed during the survey were considered to be relatively species rich and abundant compared to adjacent non-canyon habitat, and consistent with data recorded during other investigations (Last et al., 2005; Williams et al., 2001). The fish assemblage at the foot of the canyon (the deepest area surveyed) was more diverse than those observed in higher sections of the canyon, with Anguilliform (eels) and Scorpaeniform (*Paraliparis* sp.) species present that were not observed in the body of the canyon.

In reviewing KEFs in the NWMR, (Falkner et al., 2009) concluded that the canyons examined in the region exhibited habitat heterogeneity (although noted that such habitat was not restricted to canyon features) and were representative of the region. These conclusions were based on a review of existing physical and biological data from a range of sources. The observations made during the survey of the Canyons KEF were not consistent with these conclusions, finding that the habitat at different locations within the canyon comprised flat unconsolidated sediments composed of sand- and mud-sized particles (BMT Oceanica, 2016). This is consistent with the seabed in the Operational Areas and continental slope in the region more broadly (**Section 4.3.4**).

It was identified (Falkner et al., 2009) that canyons functioning as a conduit between the continental shelf and deep ocean were considered to be important. Such conduits provide a pathway for shelf production to be transported to the deep sea, as observed in river canyons. However, given the Enfield canyon is a 'blind' canyon (i.e. formed by slumping of shelf and slope sediments rather than river canyon), it may not provide this conduit function. It was noted (Falkner et al., 2009) that canyons may facilitate upwelling of nutrient-rich water, which is consistent with the observed upwelling associated with the Ningaloo Current, however, alternative explanations supported by metocean observation and modelling studies have been put forward (e.g. local wind stress (Woo et al., 2006) and internal wave action (Taylor and Pearce, 1999)). Additionally, given the depth of the head of the Enfield canyon (>200 m), there is little potential for benthic primary production on the continental shelf to be advected to the deep sea, which has been identified as an ecological function of river canyons with shallow heads (Falkner et al., 2009; Vetter and Dayton, 1999).

Given KEFs are identified based on their regional importance or ecosystem function/integrity, the Enfield canyon does not appear significantly different than the surrounding seabed although a diverse deep-water fish assemblage species richness was documented (BMT Oceanica, 2016). A pressure analysis of threats to the Canyons KEF did not identify any threats of concern, but identified ocean acidification as being of potential concern (Department of the Environment and Energy n.d.).

Continental Slope Demersal Fish Communities

The continental slope demersal fish communities in the region have been identified as a KEF of the NWS (DSEWPaC, 2012a), and overlaps the Operational Areas. The continental slope between North West Cape and the Montebello Trough has been identified as one of the most diverse slope assemblages in Australian waters, with over 508 fish species and the highest number of endemic species (76) of any Australian slope habitat (DEWHA, 2008). Additional features relating to the fish populations of this area are as follows:

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

Commonwealth Waters Adjacent to Ningaloo Reef

The Commonwealth waters adjacent to the Ningaloo Reef KEF lies adjacent to the 3 nm State waters limit along Ningaloo Reef and includes the Ningaloo AMP. Refer to **Section 4.6.1** for further information about the values and sensitivities associated with this KEF.

4.6.7.2 Key Ecological Features Within the EMBA

Ancient Coastline at 125 m Depth Contour

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 NWS and Sahul Shelf at a water depth of 125 m, which forms the Ancient Coastline at 125 m depth contour KEF (the ancient coastline). The ancient coastline lies approximately 8 km north east of Operational Area 2, extending along a line approximated by the 125 m isobath (**Figure 4-20**). The ancient coastline is not continuous throughout the NWS, and coincides with a well-documented eustatic stillstand at approximately 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 (DSEWPaC, 2012a). 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).

Exmouth Plateau

The Exmouth Plateau is a large, mid-slope, continental margin plateau that lies off the north-west coast of Australia, approximately 70 km north-east of Operational Area 1. It ranges in depth from approximately 800 to 3500 m and is a major structural element of the Carnarvon Basin (Miyazaki and Stagg, 2013). The plateau is bordered by the Rankin Platform and the Exmouth sub-basin of the Northern Carnarvon Basin to the east, the Argo Abyssal Plain to the north, and the Gascoyne and Cuvier Abyssal Plains to the north-west and south-west.

The Exmouth Plateau is overlaid by an interface between the ITF and the Indian Ocean Central Water. This interface constitutes a potential shear zone (with associated mixing) and may display substantial temporal variability both seasonally and in response to longer-term changes, such as ITF variability (Brewer et al., 2007). Internal tides are strongest during January–March (Brewer et al., 2007). Satellite observations suggest that productivity is enhanced along the northern and southern boundaries of the plateau and along the shelf edge which in turn suggests that the plateau is a significant contributor to the productivity of the region (Brewer et al., 2007). The seascape of the Exmouth Plateau is not considered to be unique by Falkner et al., (2009) in their review of KEFs in the North-west Marine Region, however, the geological origin (Exon and Willcox, 1980) and potential enhanced upwelling due to the Exmouth Plateau (Brewer et al., 2007) may constitute unique environmental values (DSEWPaC 2012a).

Fauna in the pelagic waters above the plateau are likely to include small pelagic species and nekton (Brewer et al., 2007). Protected and migratory species are also known to pass through the region including whale sharks and cetaceans.

Most actions in or adjacent to the NWMR are considered unlikely to adversely impact upon the integrity or ecosystem function of the Exmouth Plateau; ocean acidification resulting from climate change is the only potential pressure identified in the relevant bioregional plan (DSEWPaC 2012a).

Glomar Shoals

The Glomar Shoals is situated approximately 329 km north-east of Operational Area 1. These submerged shoals are large (215 km^2), complex bathymetrical features on the outer continental shelf off the Pilbara. Glomar Shoals rises gently on the south-west side of the reef from 80 m depth to a single plateau at 40 m depth. The north-eastern side of the reef rises steeply from 70 m to 40 m depth. The shoals are relatively shallow, with water depths reaching 22 to 28 m at the shallowest point. Together with Rankin Bank, these remote shallow water areas represent regionally unique habitats and are likely to play an important role in the productivity of the Pilbara region (AIMS, 2014a; Wahab et al., 2018).

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

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

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

Western Demersal Slope and Associated Fish Communities

The Western Demersal Slope is located approximately 464 km from Operational Area 2 and provides important habitat for demersal fish communities. In particular, the continental slope of the Central Western provincial bioregion supports demersal fish communities, characterised by high diversity compared with other, more intensively sampled oceanic regions of the world. Its diversity is attributed to the overlap of ancient and extensive Indo-West Pacific and temperate Australasian fauna (Williams et al., 2001). Scientists have described 480 species of demersal fish that inhabit the slope of this bioregion; 31 of these are considered endemic to the bioregion.

Wallaby Saddle

The Wallaby Saddle is located approximately 491 km south-west of Operational Area 1 in water depths ranging from 4000 to 4700 m. The Wallaby Saddle is an abyssal geomorphic feature linking the north-west margin of the Wallaby Plateau with the upper continental slope margin of the Carnarvon Basin.

Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals

The Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals KEF is located approximately 648 km from the Operational Areas, lies adjacent to the three nautical mile State waters limit surrounding Clerke and Imperieuse reefs, and includes the Mermaid Reef National Nature Park.

Ancient Coastline at 90–120 m Depth

The Ancient Coastline KEF lies approximately 670 km from Operational Area 2, and consists of a ridge comprising a submerged shoreline from a glacial period when sea levels were lower. The ancient coastline between 90 and 120 m may host relatively high benthic biodiversity and be associated with increased productivity (DSEWPaC 2012c).

Western Rock Lobster

The Western Rock Lobster KEF covers a considerable portion (around 40,000 km^2) of continental shelf waters on the lower west coast of Western Australia (approximately 670 km from Operational Area 2. It was established in recognition of the presumed ecological role played by the western rock lobster (*Panulirus cygnus*) in shelf waters (DSEWPaC, 2012c; MacArthur et al., 2007).

Commonwealth Marine Environment Surrounding the Houtman Abrolhos Islands

The Houtman Abrolhos Islands host a unique mix of temperate and tropical species, facilitated by the transport of relatively warm water and tropical larvae southwards by the Leeuwin Current (DSEWPaC 2012d). The islands host significant aggregations of breeding seabirds, supporting over one million breeding pairs, and include a range of benthic habitats and associated fisheries resources (Department of Fisheries, 2012; DSEWPaC, 2012d).

4.6.7.3 Other Sensitive Areas

Rankin Bank

Rankin Bank is on the continental shelf, approximately 225 km from the Operational Areas. While Rankin Bank is not protected and is not a KEF, along with Glomar Shoals, it 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, 2014). Rankin Bank consists of three submerged shoals delineated by the 50 m depth contour with water depths of approximately 18–30.5 m (AIMS, 2014).

Rankin Bank, along with the Glomar Shoals, was surveyed by the AIMS in 2013 as part of a co-investment project between Woodside and AIMS to better understand the habitats and complexity of the submerged shoal ecosystems. Rankin Bank represents a diverse marine environment, predominantly composed of consolidated reef and algae habitat (around 55% cover), followed by hard corals (around 5% cover), unconsolidated sand/silt habitat (around 16% cover), and benthic communities composed of macroalgae, soft corals, sponges and other invertebrates (around 3% cover) (AIMS, 2014). Hard corals are a significant component of the benthic community of some parts of the bank, with abundance in the upper end of the range observed elsewhere on the submerged shoals and banks of north-west Australia (Heyward et al., 2012).

Rankin Bank has been shown to support a diverse fish assemblage (AIMS, 2014). 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).

Indonesia

The Indonesian islands of Bali, Lombok, Sumba, Sumbawa, Flores, Savu and Pulau Roti are located within Indonesia’s Lesser Sunda ecoregion and contain significant marine and socio-economic environmental values. Such values include:

- Subtidal benthic habitats – These islands host extensive subtidal benthic habitats including fringing coral reefs, seagrass meadows and algal beds. Whilst such habitats are generally under considerable pressure due to over exploitation of resources (e.g. over-fishing), pollution and climate change induced impacts (Hutomo and Moosa, 2005), they still represent a significant environmental value within the region, supporting local subsistence fishing, tourist and aquaculture activities.
- Intertidal habitats – Mangroves are commonly distributed within estuaries and around deltas within this region of Indonesia. Such habitats form important benthic primary producing habitats, acting as nurseries for fish and shrimps, as well as maintaining an important role in coastal defence (e.g. mitigating coastal erosion) and nutrient recycling. In addition, such mangrove communities play a significant role in Indonesia’s national and global climate change mitigation strategies, given their carbon storage properties (Murdiyarso et al., 2015; Donato et al., 2011).
- Whales – As a result of seasonal upwellings, the Lesser Sunda Ecoregion hosts several species of migratory whales (up to 19 species noted), which traverse through the area, in particular the waters in between Sumba and Timor, within the Savu Sea Marine Protected Area) (Mustika et al., 2006).
- Aquaculture – Aquaculture within the region is undertaken within estuarine and marine waters focusing on a variety of species and methods, including prawns, fish and seaweed. These activities often contribute significantly to local employment and food production within the region (FAO, 2017a).
- Fisheries – As the world’s largest archipelagic state with approximately 17,500 islands, fisheries form a significant socio-economic sector. The vast majority of fishery production (up to 95 percent) comes from artisanal fishing practices (FAO, 2017b). The fisheries management area 573 (South of Java – East Nusa Tenggara), encompasses the Lesser Sunda Ecoregion and is a particular productive area with a variety of target demersal and pelagic fisheries, including, lobster, tuna, sardines and shark fisheries. Many of these fisheries are under pressure from over-exploitation, unsustainable fishing practices, under-regulation and poor management/monitoring, nevertheless they significantly contribute to the economy and social fabric within coastal communities in the region (FAO, 2017b).
- Tourism – Tourism is a major industry within the Lesser Sunda Ecoregion, with particular tourist centres in Bali, Flores, Lombok, Komodo and the Gili Islands. The marine environment within these centres is a major attraction, with beach and coastal activities a primary attraction.

The following National Parks within the Lesser Sunda Ecoregion are largely marine:

- Laut Sawu Marine National Park – The Marine National Park is a known migration route for several cetacean species, including the blue whale and sperm whale. Other cetacean species such as pygmy killer whales, melon-head whale, short-finned pilot whales and numerous dolphin species (including Risso's dolphin, Fraser's dolphin, common dolphin, bottlenose dolphin and spinner dolphin) are known to frequent the Marine National Park. Several species of marine turtle, including the green turtle, hawksbill turtle and leatherback turtle have also been recorded in the Marine National Park. The Marine National Park covers a range of habitats and species diversity, including
  - 532 corals species which include 11 endemic and sub endemic species
  - 350 reef fish species
  - fifteen mangrove species are recorded that represent nine families of mangrove
  - ten seagrass species
  - deep-water habitats such as seamounts, deep-water canyons, straits (migratory corridors)
  - main migratory corridors and habitats for 14 whales species, seven dolphin species, and dugong
  - Habitats for five sea turtle species (green, leatherback, olive ridley, loggerhead, and flat back) as well as for large marine fauna such as sharks, napoleon, parrotfish and groupers
- Manupeu Tanadaru National Park and Laiwangi Wanggameti National Park, both located on Sumba, are important for endemic bird species and protected plant species.
- Komodo National Park is located between the islands of Sumbawa and Flores and is composed of three major islands (Rinca, Komodo, and Padar) and numerous smaller ones of volcanic origin. This national park lies within the Wallacea Biogeographical Region and has been identified as a global conservation priority area (UNESCO World Heritage Listing 609). The environment within the park is noted for its terrestrial and marine ecosystems and covers a total area of 219,322 ha. The coral reefs fringing the Komodo islands host a significant diversity of marine species, including sea turtles, whales, dolphins and dugongs.

The southern coast of Java, within the Southern Java ecoregion, maintains many of the same environmental and socio-economic values as the Lesser Sunda ecoregion, albeit with increased population pressure as the most populated island in Indonesia.

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 Consultation Objectives

In support of this EP, Woodside has sought to:

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

5.4 Stakeholder Expectations for Consultation

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

NOPSEMA:

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

- *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.

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

Stakeholder	Relevant to activity	Reasoning
Commonwealth Government department or agency		
Australian Border Force (ABF)	Yes	Responsible for coordinating maritime security.
Australian Fisheries Management Authority (AFMA)	No	Responsible for managing Commonwealth fisheries. No Commonwealth Fisheries are active in the Operational Areas. Limited potential for interaction with Western Deepwater Trawl Fishery and North West Slope and Trawl vessels along the tow route. Although the Western Skipjack Fishery and Western Billfish Fishery are not active in the area, given the fishery boundaries, water depth and fishing methods, Woodside has chosen to also provide information to AFMA.
Australian Hydrographic Office (AHO)	Yes	Response for maritime safety and Notices to Mariners.
Australian Maritime Safety Authority (AMSA)	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth waters. Proposed activity has a hydrocarbon spill risk, which may require AMSA assistance for pollution response.
Department of Agriculture, Water and the Environment (DAWE)	Yes	Responsible for implementing Commonwealth policies and programs to support agriculture, water resources, the environment and our heritage. The proposed activity has the potential impact to DAWE’s interests in the prevention of introduced marine species. No Commonwealth Fisheries are active in the Operational Areas. Limited potential for interaction with Western Deepwater Trawl Fishery and North West Slope and Trawl vessels along the tow route. Although the Western Skipjack Fishery and Western Billfish Fishery are not active in the area, given the fishery boundaries, water depth and fishing methods, Woodside has chosen to also provide information to DAWE.
Department of Defence (DoD)	Yes	Responsible for defending Australia and its national interests. The proposed Operational Area overlaps the Defence training area.
Commonwealth Department of Industry, Science, Energy and Resources (DISER)	Yes	Department of relevant Commonwealth Minister and is required to be consulted under the Regulations.
Director of National Parks (DNP)	Yes	Responsible for managing AMPs and therefore requires an awareness of activities that occur within AMPs, and an understanding of potential impacts and risks to the values of parks (NOPSEMA guidance note: N-04750-GN1785 A620236, June 2020). Titleholders are required to consult DNP on offshore petroleum and greenhouse gas exploration activities if they occur in, or may impact on the values of marine parks, including where potential spill response activities may occur in the event of a spill (i.e. scientific monitoring).

Stakeholder	Relevant to activity	Reasoning
WA Government department or agency		
Department of Biodiversity, Conservation and Attractions (DBCA)	No	Responsible for managing WA's parks, forests and reserves. Planned activities do not impact DBCA's functions, interests or activities; however, Woodside has chosen to provide information given the proximity of the proposed artificial reef to the Ningaloo State Marine Park.
Department of Mines, Industry Regulation and Safety (DMIRS)	Yes	Department of relevant State Minister and is required to be consulted under the Regulations.
Department of Primary Industries and Regional Development (DPIRD)	Yes	Responsible for managing State fisheries. Potential for interaction during proposed activities with the Pilbara Line Fishery in the Operational Area. In accordance with the Policy on Habitat Enhancement Structures in Western Australia (Department of Fisheries, 2012), once an approved artificial reef is successfully deployed, the ownership and liability associated with the habitat enhancement structure will move to DPIRD (**Section 1.1**). The long-term monitoring and management of the reef remain with the artificial reef permit applicant (**Section 7.5.4**).
Department of Transport (DoT)	Yes	Legislated responsibility for oil pollution response in State waters. Proposed activity has a hydrocarbon spill risk, which may require DoT response in State waters.
Commonwealth fisheries*		
North-West Slope Trawl Fishery	No	The fishery overlaps Operational Area 1 and the tow route for Operational Area 2, however, does not overlap the proposed IAR location, however, fishers have not been active in the area over the last five years. Woodside has still chosen to provide information to Licence Holders.
Southern Bluefin Tuna Fishery	No	The fishery has not been active in the Operational Area within the last five years. Fishing will not occur in the Operational Area. Australia has a 35% share of total global allowable catch of Southern Bluefin Tuna, which is value-added through tuna ranching near Port Lincoln, South Australia (Australian Southern Bluefin Tuna Industry Association).
Western Tuna and Billfish Fishery	No	The fishery has not been active in the Operational Area within the last five years. Woodside has chosen to provide information to Licence Holders given the overlap with the Operational Area.
Western Deepwater Trawl Fishery	No	The fishery overlaps Operational Area 1 and the tow route for Operational Area 2, however, does not overlap the proposed IAR location or the current location of the RTM, however, fishing effort is concentrated south of the Operational Areas. Woodside has still chosen to provide information to Licence Holders
Western Skipjack Fishery	No	The fishery has not been active in the Operational Area within the last five years. Woodside has chosen to provide information to Licence Holders given the overlap with the Operational Area.

Stakeholder	Relevant to activity	Reasoning
State fisheries*		
Mackerel Managed Fishery – Pilbara (Area 2)	No	Although the fishery overlaps the Operational Area, it has not been active in the Operational Area within the last five years. The tow route overlaps the fishery. However, fishers will not be active based on the distribution of target species (Spanish Mackerel), surface trolling fishing methods, and the water depth of the proposed artificial reef (previous advice from the Western Australian Fishing Industry Council [WAFIC] is that fishers are only active at water depths less than 70 m).
South West Coast Salmon Managed Fishery	No	Although the fishery overlaps the Operational Area, it has not been active in the Operational Area within the last five years. The tow route overlaps the fishery. However, based on the **Section 4.5.3** and previous advice from WAFIC, no fishing takes place north of the Perth metropolitan area, and occurs as net fishing from the shore.
West Coast Deep Sea Crustacean Managed Fishery	No	Although the fishery overlaps the Operational Area, it fishery has not been active in the Operational Area within the last five years. In recent years fishing has only been undertaken along the continental shelf edge and in waters south of Exmouth (West Coast Deep Sea Crustacean Managed Fishery; DPIRD, 2005). Fishery uses baited pots in a long-line formation in shelf edge waters deeper than 150 m (**Section 4.5.3**).
Pilbara Crab Managed Fishery	No	Although the fishery overlaps the Operational Area, it has not been active in the Operational Area within the last five years. The tow route overlaps the fishery. However, it is over an area closed to fishing, and target species (blue swimmer crab) are only found in waters up to 50 m deep (**Section 4.5.3**).
West Australian Sea Cucumber Fishery	No	Although the fishery overlaps the Operational Area, it has not been active in the Operational Area within the last five years. This is a dive and wade fishery, with activities generally restricted to waters less than 30 m deep (previous engagement with WAFIC).
Marine Aquarium Fishery	No	Although Operational Area 2 overlaps the area of this fishery, it is a dive and wade fishery with activities generally restricted to waters less than 30 m deep (engagement with WAFIC).
Specimen Shell Fishery	No	Although Operational Area 2 overlaps the area of this fishery, it is a dive and wade fishery with activities generally restricted to waters less than 30 m deep (engagement with WAFIC).
Developmental Octopus Fishery	No	Although Operational Area 2 overlaps the area of this fishery, the target fish species occurs in inshore waters up to 70 m deep, from Shark Bay to Esperance, so further south than the Operational Area (DPIRD – Resource Assessment Report – November 2018).
Pilbara Demersal Scalefish Fishery		

Stakeholder	Relevant to activity	Reasoning
• Pilbara Trawl Fishery	No	The Operational Area is outside of the Pilbara Trawl Fishery.
• Pilbara Trap Fishery	No	The Operational Area is outside of the Pilbara Trap Fishery.
• Pilbara Line Fishery	Yes	The fishery overlaps the Operational Area and DPIRD data indicate active fishing within the Operational Area.
Industry		
BHP	Yes	Adjacent Titleholder.
Santos	Yes	Adjacent Titleholder.
Shell	Yes	Tow route overlaps Operational Areas.
KUFPEC	Yes	Tow route overlaps Operational Areas.
Chevron	Yes	Tow route overlaps Operational Areas.
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 commercial fishers with licences in Commonwealth waters. No Commonwealth Fisheries are active. Limited potential for interaction with Western Deepwater Trawl Fishery and North West Slope and Trawl vessels along the tow route. Although the Western Skipjack Fishery and Western Billfish Fishery are not active in the area, given fishery boundaries, water depth and fishing methods, Woodside has chosen to also provide information to the CFA.
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.
Recfishwest	Yes	Represents the interests of recreational fishers in WA. Activities have the potential to impact recreational fishers. Recfishwest has prepared and submitted an application for an artificial reef permit for installing the RTM and reef modules to create an IAR to positively impact recreational fishers. Will undertake long-term (30-year) monitoring and management of the reef in accordance with the artificial reef permit application.
Marine Tourism WA	Yes	Represents the interests of recreational fishers in WA. Activities have the potential to impact recreational fishers.
WA Game Fishing Association	Yes	Represents the interests of charter owners and operators in WA. Activities have the potential to impact game fishers.

Stakeholder	Relevant to activity	Reasoning
Western Australian Fishing Industry Council (WAFIC)	Yes	Represents the interests of commercial fishers with licences in State Waters. There is potential for interaction with commercial fishers in the Pilbara Line Fishery.
Other Stakeholders		
Exmouth-based charter boat, tourism and dive operators	Yes	There has been no recent fishing effort in the Operational Area by charter boat operators, however Woodside has chosen to consult charter operators.
Cape Conservation Group	Yes	Volunteer not-for-profit organisation that is involved in protecting the terrestrial and marine environment of the North West Cape.
Protect Ningaloo	Yes	Volunteer not-for-profit organisation that is involved in protecting the terrestrial and marine environment of Ningaloo Reef
Exmouth Community Reference Group	Yes	Group established in 2002 to provide a forum for local community, industry and government stakeholders and the oil and gas industry to discuss operations and community issues.
Exmouth Game Fishing Club	Yes	Exmouth based game fishing club, which hosts a number of fishing tournaments in the region.
Exmouth Chamber of Commerce and Industry (ECCI)	Yes	Not-for-profit group that represents local businesses.
Shire of Exmouth	Yes	Local government entity for the Exmouth region. Broader interest in activities in the region.
Ningaloo Coast World Heritage Advisory Committee	Yes	Activities will not occur in the Ningaloo WHA; however, given the proximity of the WHA, Woodside has chosen to provide information to the Committee.
Nganhurra Thanardi Garrbu Aboriginal Corporation	Yes	Registered Native Title body for the Exmouth region.

** 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.* ***Table 4-10*** *provides a detailed assessment of Commonwealth and State fisheries within or adjacent to the Operational Area.*

5.5 Stakeholder Consultation

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

Woodside undertook additional consultation following an increase in scope of the EP to include the IAR. Complementary to this, is the consultation undertaken by Recfishwest as part of the Sea Dumping Permit. The consultation requirements for a Sea Dumping Permit are required under separate legislation and are therefore different to those for an EP. An overview of the Recfishwest consultation for the Sea Dumping Permit can be found in **Section 5.6**.

The Consultation Information Sheet (**Appendix F**, reference 1.2) is published on the Woodside website and includes a toll-free 1800 phone number. The Additional Consultation Information Sheet (**Appendix F**, reference 2.2) is published on the Woodside website and includes a toll-free 1800 phone number.

Since August 2019, Woodside has undertaken ongoing engagement with Recfishwest on the suitability and acceptability of repurposing the RTM as an IAR, and to assure the requirements of the Sea Dumping Permit and the EP are met.

Engagement with Recfishwest has included/found:

- Discussion on the purpose and design of the RTM and consideration of its suitability and acceptability to be repurposed as an IAR.
- The RTM alone is unlikely to meet the expectations of an IAR and purpose-built reef modules would be required.
- Eliminating or removing of contaminants associated with the RTM (including possible engineering solutions) would need to be managed to ensure acceptability of the RTM as an IAR.
- Mapping and consideration of stakeholders' consultation requirements to meet the requirements of the Sea Dumping Act, including reef design, location and concept.
- An understanding of the outcomes of stakeholder consultation to inform the activity and controls measures in the artificial reef permit, and EP.

Table 5-2: Stakeholder consultation plan activities

Stakeholder	Information provided	Stakeholder response	Woodside response
Australian Government department or agency			
ABF	On 10 October 2019 Woodside emailed ABF advising of the proposed activity (**Appendix F**, reference 1.1) and provided a Consultation Information Sheet.	No feedback received.	Woodside has addressed maritime security-related issues in **Section 6** of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed ACS providing information on repurposing the RTM	No feedback received.	Woodside has addressed maritime security-related issues in **Section 6** of this

Stakeholder	Information provided	Stakeholder response	Woodside response
	(**Appendix F**, reference 2.1) and provided a Consultation Information Sheet.		EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
AFMA	On 2 July 2020, Woodside emailed AFMA providing information on repurposing the RTM (**Appendix F**, reference 2.9) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Woodside to further consult AFMA.
	On 17 July 2020, Woodside emailed AFMA asking if they would like to discuss the information provided (**Appendix F**, reference 2.34).	No feedback received.	Woodside has addressed Commonwealth fisheries issues. Woodside considers the level of consultation to be adequate.
AHO	On 10 October 2019 Woodside emailed AHO advising of the proposed activity (**Appendix F**, reference 1.15) and provided a shipping fairways map (**Appendix F**, reference 1.16) and a consultation Information Sheet.	No feedback received.	Woodside will notify the AHO no less than four working weeks before operations commence. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed AHO providing information on repurposing the RTM (**Appendix F**, reference 2.25) and provided a shipping lane map (**Appendix F**, reference 2.26) and a Consultation Information Sheet.	On 3 July 2020, the AHO responded acknowledging receipt of the email.	Woodside will notify the AHO no less than four working weeks before operations commence. Woodside considers the level of consultation to be adequate.
AMSA (marine safety)	On 10 October 2019 Woodside emailed AMSA advising of the proposed activity (**Appendix F**, reference 1.15) and provided a shipping fairways map (**Appendix F**, reference 1.16) and a consultation Information Sheet.	On 10 October 2019 AMSA emailed Woodside requesting the Master to email AMSA's Joint Rescue Coordination Centre (JRCC) at least 24–48 hours before operations commence and provided details of information required by the Centre in that communication. AMSA requested that the Australian Hydrographic Office (AHO) be contacted through datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners. AMSA provided advice on obtaining vessel traffic plots, including digital datasets and maps.	Woodside will notify AMSA's JRCC at least 24–48 hours before operations commence for each survey. Woodside will notify the AHO no less than four working weeks before operations commence. Woodside notes AMSA's advice on vessel traffic information.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 2 July 2020, Woodside emailed AMSA providing information on repurposing the RTM (**Appendix F**, reference 2.23) and provided a shipping lane map (**Appendix F**, reference 2.26) and a Consultation Information Sheet.	On 3 July 2020 AMSA emailed Woodside requesting the Master to email AMSA's JRCC at least 24–48 hours before operations commence and provided details of information required by the JRCC in that communication. AMSA requested that the AHO be contacted through datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners. AMSA provided advice on obtaining vessel traffic plots, including digital datasets and maps.	Woodside will notify AMSA's JRCC at least 24–48 hours before operations commence. Woodside will notify the AHO no less than four working weeks before operations commence. Woodside notes AMSA's advice on vessel traffic information.
AMSA (marine pollution)	On 10 October 2019 Woodside emailed AMSA advising on its consultation approach for the Oil Pollution First Strike Plan (**Appendix F**, reference 1.17) consultation Information Sheet.	No feedback received.	No response required.
	On 1 November 2019 Woodside emailed AMSA a copy of the Oil Pollution First Strike Plan (**Appendix F**, reference 1.19).	No feedback received.	Woodside has addressed oil pollution planning and response in **Appendix D**. Woodside considers the level of consultation to be adequate.
	On 6 July 2020, Woodside emailed AMSA providing information on repurposing the RTM (**Appendix F**, reference 2.24) and provided a shipping lane map (**Appendix F**, reference 2.26) and a Consultation Information Sheet.	No feedback received.	On 28 July 2020, Woodside provided a copy of the First Strike Plan to AMSA for its review.
DAWR	On 10 October 2019 Woodside emailed DAWR advising of the proposed activity and provided information on invasive marine species (**Appendix F**, reference 1.9) and a consultation Information Sheet.	On 11 October 2019 DAWR emailed Woodside acknowledging receipt of its consultation information and that a response will be provided within 10 business days.	Woodside notes DAWR's advice.
		No feedback received.	Woodside has addressed maritime biosecurity and Commonwealth fishing related issues in **Section 6** of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed DAWR providing information on repurposing the RTM		Woodside awaited DAWR's response. No feedback was provided. Issues regarding

Stakeholder	Information provided	Stakeholder response	Woodside response
	(**Appendix F**, reference 2.7), information on invasive marine species, provided a Commonwealth Fisheries map (**Appendix F**, reference 2.13) and a Consultation Information Sheet.	On 3 July 2020 DAWR emailed thanking Woodside for the information and that it would provide comments by 24 July 2020.	invasive marine species and Commonwealth Fisheries has been addressed. Woodside considers the level of consultation to be adequate.
	On 6 July 2020, Woodside emailed DAWR noting the EP will be submitted to NOPSEMA and not DMIRS (**Appendix F**, reference 2.8).		
DoD	On 10 October 2019 Woodside emailed DoD advising of the proposed activity (**Appendix F**, reference 1.5) and provided a defence map (**Appendix F**, reference 1.6) and a consultation Information Sheet.	No feedback received.	Consultation Information Sheet, and defence map provided. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed DoD providing information on repurposing the RTM (**Appendix F**, reference 2.13) and provided a defence map (**Appendix F**, reference 2.15) and a consultation Information Sheet.	On 21 July 2020, DoD responded advising it has no objections to the proposed reef and noted the activity is within the North West Exercise area and restricted airspace. DoD advised that unexploded ordnance (UXO) may be present on and in the seafloor of the proposed area and that activities must be conducted at Woodside's risk. DoD requested a minimum of five weeks notice before activities commence, and that Woodside should liaise with the Australian Hydrographic Service three weeks before the activity commencing.	On 23 July 2020, Woodside emailed DoD requesting a shape file for the UXO to map against the proposed reef site. Woodside will provide a minimum of five weeks notice before activities commencing.
	On 6 July 2020, Woodside emailed DoD noting the EP will be submitted to NOPSEMA and not DMIRS (**Appendix F**, reference 2.14).	On 24 July 2020, DoD requested an email be sent to the UXO section.	On 24 July 2020, Woodside emailed the UXO section requesting a shape file for the two UXO areas off North West Cape.
		On 31 July 2020, DoD advised shape files are conservative and would likely become smaller following ongoing reviews. DoD advised there is no specific UXO issue associated with the location that would impact the proposed activity.	Woodside notes there would be no UXO issue based on the location of the proposed reef.
DISER	On 10 October 2019 Woodside emailed DIIS advising of the proposed activity (**Appendix F**, reference 1.1) and provided a consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 2 July 2020, Woodside emailed DIIS providing information on repurposing the RTM (**Appendix F**, reference 2.1) and provided a Consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
DNP	On 22 November 2019 Woodside emailed DNP advising of the proposed activity (**Appendix F**, reference 1.22), considering potential risks for Australian Marine Parks, and provided a consultation Information Sheet.	On 12 December 2019 DNP responded noting planned activity does not overlap any AMPs, noting the EP guidance note, North-west Marine Parks Network Management Plan 2018, and that it does not require further notification of progress in relation to the activity. Also DNP should be made aware of any incidence within a marine park.	On 13 December 2019, Woodside thanked DNP for its response and the information provided including emergency response details.
	On 2 July 2020, Woodside emailed DNP providing information on repurposing the RTM (**Appendix F**, reference 2.27), considering potential risks for AMPs, and provided a Consultation Information Sheet.	No feedback received.	Woodside to further consult with DNP.
	On 2 July 2020, Woodside emailed DNP noting the EP will be submitted to NOPSEMA and not DMIRS (**Appendix F**, reference 2.28).		
	On 23 July 2020, Woodside emailed DNP asking if they would like to discuss the proposed activity or would like further information (**Appendix F**, reference 2.37).	• On 23 July 2020, DNP wrote to Woodside and raised these points: • Welcome the avoidance of AMPs during tow, and noted no authorisations are required from DNP. • Ensure the EP meets the requirements of the North west Marine Parks Network Management Plan 2018. • Ensure the EP identifies and manages all impacts and risks on AMPS to an acceptable level, and clearly demonstrates the activity will not be inconsistent with the North-west Marine Parks Network Management Plan 2018. • The EP details the of assessment of removal options, and environmental outcomes of each option. • The EP considers the selection of the location and design of the reef.	On 29 July 2020, Woodside advised it would consider and respond to DNP's feedback and offered a video conference to discuss the issues further.
			On 5 August 2020, Woodside responded to DNP: • The activity must not contravene the values and objectives set out for any sensitive feature of the environment proclaimed under the EPBC Act, including for AMPs and WHPs Properties. This has been done through assessment of the impacts and risks of both the activity to place the reef, and the reef remaining in-situ permanently. • Commonwealth Marine Park areas and reserves, threatened species,

Stakeholder	Information provided	Stakeholder response	Woodside response
		• The EP considers the potential for indirect ecosystem changes within the Ningaloo Marine Park. • The location of the reef is more than 1 km away from the Marine Park. • Offered to share CSIRO documents mapping deepwater fish habitats in the Marine Park. • Consider the potential impact on threatened or protected species to recreational capture, and the likelihood of vessel strike on cetaceans and whales. • Timing of installation of the reef should not coincide with peak periods of whale behaviour, and the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna should be considered for the reef activity. • Potential for the reef to attract commercial fisheries and the potential impact on the Marine Park and how it will be managed. • What arrangements are in place for the long-term monitoring and maintenance of the reef. • Requested further information on the location of flushing fluids, composition of waste, and planned disposal method. • The Nganhurra Thanardi Garrbu Aboriginal Corporation be consulted as well as nature-based tourism industry operators. • The EP explains why the foam, risers and EHU will be left in place as opposed to being removed. • The grout option is detailed in the EP including product details and degradation analysis. • The EP includes information on the quantity of plastics and foam to remain encapsulated or exposed. • Further information on the tidal windows in the RTM, including their composition and why they require minimal exposure to the environment.	non-indigenous marine species (NIMS), user interactions with the Marine Parks and the reef area and EPBC listed threatened and protected species, BIAs, have all been included and assessed in the artificial reef permit process. • The EP will include an assessment of all removal and disposal options and the environmental risks and impacts. • The proposed reef location was selected following multiple rounds of consultation by Recfishwest, and site survey. • The proposed reef layout and design will meet the purpose of the reef (access to enhanced deepwater fishing opportunities on productive fish habitat for target species). • Many species are unlikely to migrate to the new habitat provided by an artificial reef; e.g. species with high site fidelity (i.e. site-attached), and species associated with bare sand substrates. Indirect ecosystem changes have been considered. • The proposed artificial reef will be located a significant distance from any known natural coral reefs within the WHA. • We would appreciate the CSIRO commissioned maps of deepwater fish habitats in the Ningaloo Marine Park • The revision of the EP assesses the potential impacts and risks to any EPBC Part 3 protected species from

Stakeholder	Information provided	Stakeholder response	Woodside response
		• If any components of the reef modules will contain plastics, and product information for all surface coatings included in the EP. • Confirm the RTM has not been treated with anti-fouling paints containing tributyltin (TBT) within the last 3–5 years. • DNP notified on the decision of the EP, on commencement of reef activities, and its completion. • DNP should be made aware (as soon as possible) of any oil/gas pollution incidents that occur within a marine park and are likely to impact on a marine park.	placing the RTM as a component of the artificial reef. • The time period targeted for towing and installing the RTM does not overlap the annual humpback whale migration. Although there could be overlap with part of the peak period for southbound pygmy blue whales, the activity will not overlap the peak period for the northbound pygmy blue whales. The reef is more than 20 km from the boundary of the possible foraging area for pygmy blue whales. • The revised EP assesses of the potential impacts commercial fishers and any increased activity is not predicted to have any impacts on the natural and socio-economic values of the marine park. • Visual inspections of the RTM in 2019 showed no evidence of NIMS. It is not expected that the artificial reef will host NIMS once installed, given the depth and location. Visual inspections will be conducted throughout the 30-year monitoring period. • A Long-term Monitoring Plan (LTMP) for the artificial reef will be implemented over a period of 30 years. • It is planned that the EHU will be flushed of any residual contaminants whilst the RTM is in its current location. The EHU contains small quantities of monethylene glycol, a demulsifier and a scale inhibitor, and the EP includes an assessment of the potential impacts when these

Stakeholder	Information provided	Stakeholder response	Woodside response
			fluids are released subsurface to the ocean from the EHU tail. • Consultation materials have been provided to the Nganhurra Thanardi Garrbu Aboriginal Corporation and nature-based charter operators in Exmouth. • Further assessment is currently being undertaken on the option to remove the risers and EHU. A full assessment of the impacts of the risers if they are left within the RTM, will be included in the EP. • Physically removing the foam has been investigated, but due to the location and no access hatch into the compartment, this is not considered practicable. • Woodside provided an overview on the assessment of the grout and foam. • If the risers and EHU remain in the RTM, options to grout the external windows to isolate them within the RTM are being considered. • The revised EP includes an assessment of the potential impacts of release of hydraulic fluid. Given the chemical composition of the fluid, the very small volumes that could be released, and the long timeframe of the release, no significant environmental impacts are predicted to occur. • The concrete reef modules are designed to have a minimum of 30 years design life. All material composition and chemistry of all reef

Stakeholder	Information provided	Stakeholder response	Woodside response
			materials will be included in the artificial reef permit. • The RTM was painted with antifouling paints during its construction. It has not been re-treated. The anit-foulant paint is depleting as evident by the level of marine growth on the RTM. The antifoulant paint used did not contain TBT. • The DNP will be notified when a decision is made on the EP, and on commencement and end of activities. • The Marine Compliance Duty Officer will be notified as soon as possible on the details provided if there is an oil / gas incident within a marine park or likely to impact on a marine park.
		On 6 August 2020, DNP thanked Woodside for responding to its feedback and provided a CSIRO report on mapping deepwater fish habitats at Ningaloo. DNP advised it would like to meet to discuss the points raised and Woodside's response.	On 24 August 2020, Woodside emailed DNP and advised the EP would be resubmitted and available on the NOPSEMA website. Woodside is happy to meet following this resubmission as it will show the updates made.
		On 24 August 2020, DNP agreed to meet once the revised EP is on the NOPSEMA website.	Woodside to coordinate a meeting once the revised EP is on the NOPSEMA website, and to discuss further the issues raised including hydraulic fluid, plastics, and TBT, and inclusion of the North west Marine Parks Network Management Plan 2018.
Western Australian Government department or agency or advisory body			
DBCA	On 2 July 2020, Woodside emailed DBCA providing information on repurposing the RTM (**Appendix F**, reference 2.1) and provided a Consultation Information Sheet.	On 13 July 2020, DBCA responded noting is has no comments in relation to its responsibilities.	Woodside notes DBCA has no comments to provide based on its responsibilities.

Stakeholder	Information provided	Stakeholder response	Woodside response
DMIRS	On 10 October 2019 Woodside emailed DMIRS advising of the proposed activity. (**Appendix F**, reference 1.1) and provided a consultation Information Sheet.	On 28 October 2019 DMIRS emailed Woodside acknowledging receipt of the consultation information. DMIRS noted that disposal of the riser turret mooring would not be covered in the EP, but sought clarification on disposal options.	On 14 November 2020, Woodside emailed DMIRS and noted it is considering a range of options for disposal of the RTM. A 500 m exclusion zone remains in place around the RTM which is located about 38 km from the North West Cape. Offered to meet DMIRS.
		On 15 November 2019 DMIRS thanked Woodside for its response and state no further information is required at this stage, and requested to be kept informed of activities.	Woodside to keep DMIRS informed of activities.
	On 2 July 2020, Woodside emailed DMIRS providing information on repurposing the RTM (**Appendix F**, reference 2.1) and provided a Consultation Information Sheet.	On 23 July 2020, DMIRS thanked Woodside for keeping DMIRS informed about activities in Commonwealth waters. DMIRS noted the options for repurposing the RTM will be included in the EP Plan, and that it has reviewed the information provided and no further details are required. It requested an update once more certainty around the final RTM placement is determined.	Woodsides notes DMIRS requires no further information, and will advise DMIRS of the RTM's final location once in place.
DPIRD	On 10 October 2019 Woodside emailed DPIRD advising of the proposed activity (**Appendix F**, reference 1.3) and provided a State Fisheries map relevant to the proposed activity (**Appendix F**, reference 1.4) and a consultation Information Sheet.	No feedback received.	Woodside to re-consult DPIRD to seek and consider feedback for this Environment Plan.
	On 1 November 2019 Woodside sent a follow-up email seeking stakeholder feedback. Woodside also offered to meet with DPIRD.	No feedback received.	Woodside to call DPIRD as part of consultation.
	On 12 November 2019 Woodside called DPIRD and left voicemail to discuss the activity.	No response or call back.	Woodside to re-consult DPIRD to seek and consider feedback for this Environment Plan.
	On 25 November 2019 Woodside called DPIRD and sought feedback on a number of EP consultation activities, including this EP,	DPIRD thanked Woodside for the information provided.	Woodside agreed to provide an extension to the feedback deadline and re-emailed consultation materials.

Stakeholder	Information provided	Stakeholder response	Woodside response
	Woodside noted it had consulted WAFIC and relevant licence holders.		
	On 25 November 2019 Woodside emailed DPIRD providing information on EPs currently under consultation.	On 25 November 2019 DPIRD thanked Woodside by way of an email response.	Woodside has attempted on a number of occasions to contact and consult DPIRD via email and phone calls and considers the level of consultation appropriate.
	On 2 July 2020, Woodside emailed DPIRD providing information on repurposing the RTM (**Appendix F**, reference 2.3) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	On 3 July 2020, DPIRD emailed Woodside advising it would provide comments by the due date.	On 3 July 2020, Woodside emailed DPIRD advising it will await its response.
DoT	On 10 October 2019 Woodside emailed DoT advising on its consultation approach for the Oil Pollution First Strike Plan (**Appendix F**, reference 1.17) consultation Information Sheet	On 10 October 2019 Woodside received an auto response from DoT in response to its consultation information.	No further action.
	On 30 October 2019 Woodside emailed DoT a copy of the Oil Pollution First Strike Plan (**Appendix F**, reference 1.18)	On 5 December 2019 DoT emailed Woodside seeking clarification on the following items. • Areas of duplication • Crude oil type • Condensate • Response options • Potential receptors • Shoreline impact timing DoT also requested Tactical Response Plans detailed in the First Strike Plan.	Woodside emailed DoT on 6 December 2019 providing responses to the DoT's questions, noting that the First Strike Plan would be updated to reflect the responses prior to submission to NOPSEMA. Woodside committed to sending DoT a final version of the Plan following acceptance by NOPSEMA.
	On 2 July 2020, Woodside emailed DoT providing information on repurposing the RTM (**Appendix F**, reference 2.1) and provided a Consultation Information Sheet.	On 17 July 2020, DoT emailed Woodside requesting consultation, as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangement, if there is a risk of a spill impacting State waters from the activity.	Woodside will consult with DoT as per the requirements of the Guidance Note.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 24 and 27 July 2020, Woodside called DoT to provide an overview of the Oil Pollution First Strike Plan, in advance of seeking DoT comments. Woodside provided an overview of changes to the plan: • Addition of Operational Area 2 to enable the placement of the RTM on the seafloor • Credible Scenario-06 covers potential spill of marine diesel from the towing vessel due to a vessel collision. • For Credible Scenario-06 there is shoreline impact. • Woodside has strengthened its shoreline protection and deflection and shoreline clean-up resources to ensure that a robust nearshore/shoreline response can be delivered. • These changes have been reflected across both the Oil Spill Preparedness and Response Mitigation Assessment and First Strike Plan documents. • The First Strike Plan has been amended to reflect the updated incident command roles required by the WA DoT.	DoT: • Acknowledged change of activity • Acknowledged addition of Operational Area 2 to the hydrocarbon spill assessment • Advised it would endeavour to review the plan and provide comment by 11 August 2020.	On 24 July 2020, Woodside sent the Oil Pollution First Strike Plan to DoT for its review.
		On 4 August 2020, emailed Woodside thanking it for the First Strike Plan and advised it has no further queries but requested a copy of the final plan.	Woodside will provide DoT with a final copy of the First Strike Plan.
Commonwealth Fisheries			
North West Slope and Trawl	On 7 July 2020, Woodside emailed Licence Holders providing information on repurposing the RTM (**Appendix F**, reference 2.11) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Email, Consultation Information Sheet and Commonwealth Fisheries map provided. Woodside considers the level of consultation to be adequate.
Western Tuna and Billfish	On 7 July 2020, Woodside emailed Licence Holders providing information on repurposing the RTM (**Appendix F**, reference 2.11) and provided a Commercial Fisheries map	No feedback received.	Email, Consultation Information Sheet and Commonwealth Fisheries map provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
	(**Appendix F**, reference 2.12) and a Consultation Information Sheet.		
Western Deepwater Trawl	On 7 July 2020, Woodside emailed Licence Holders providing information on repurposing the RTM (**Appendix F**, reference 2.11) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Email, Consultation Information Sheet and Commonwealth Fisheries map provided. Woodside considers the level of consultation to be adequate.
Western Skipjack	On 7 July 2020, Woodside emailed Licence Holders providing information on repurposing the RTM (**Appendix F**, reference 2.11) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Email, Consultation Information Sheet and Commonwealth Fisheries map provided. Woodside considers the level of consultation to be adequate.
State Fisheries			
Pilbara Line Fishery	On 25 October 2019 Woodside emailed Licence Holders advising of the proposed activity and potential implications and mitigation and management measures for fishers (**Appendix F**, reference 1.3) and provided a State fisheries map relevant to proposed activity (**Appendix F**, reference 1.4) and a consultation Information Sheet.	No response received.	Woodside has also consulted WAFIC who have provided a response on behalf of commercial fishers. Woodside considers the level of consultation and information provided as appropriate to make an informed decision on how activities could impact fishers.
	On 7 July 2020, Woodside emailed Licence Holders providing information on repurposing the RTM (**Appendix F**, reference 2.11) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Woodside has also consulted WAFIC who have provided a response on behalf of commercial fishers. Woodside considers the level of consultation and information provided as appropriate to make an informed decision on how activities could impact fishers.
Industry			
BHP	On 10 October 2019 Woodside emailed BHP advising of the proposed activity (**Appendix F**, reference 1.7) and provided a titles map relevant to the proposed activity (**Appendix F**,	No feedback received.	Email, titles map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
	reference 1.8) and a consultation Information Sheet.		
	On 2 July 2020, Woodside emailed BHP providing information on repurposing the RTM (**Appendix F**, reference 2.16) and provided a Titles map relevant to the proposed activity (**Appendix F**, reference 2.17) and a Consultation Information Sheet.	No feedback received.	Email, titles map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Santos	On 10 October 2019 Woodside emailed Santos advising of the proposed activity (**Appendix F**, reference 1.7 and provided a titles map relevant to the proposed activity (**Appendix F**, reference 1.8) and a consultation Information Sheet.	No feedback received.	Email, titles map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed Santos providing information on repurposing the RTM (**Appendix F**, reference 2.16) and provided a Titles map relevant to the proposed activity (**Appendix F**, reference 2.17) and a Consultation Information Sheet.	No feedback received.	Email, titles map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Shell	On 2 July 2020, Woodside emailed Shell providing information on repurposing the RTM (**Appendix F**, reference 2.16) and provided a Titles map relevant to the proposed activity (**Appendix F**, reference 2.17) and a Consultation Information Sheet.	No feedback received.	Email, titles map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
KUFPEC	On 2 July 2020, Woodside emailed KUFPEC providing information on repurposing the RTM (**Appendix F**, reference 2.16) and provided a Titles map relevant to the proposed activity (**Appendix F**, reference 2.17) and a Consultation Information Sheet.	No feedback received.	Email, titles map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Chevron	On 2 July 2020, Woodside emailed Chevron providing information on repurposing the RTM (**Appendix F**, reference 2.16) and provided a Titles map relevant to the proposed activity	No feedback received.	Email, titles map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
	(**Appendix F**, reference 2.17) and a Consultation Information Sheet.		
Industry representative organisations			
APPEA	On 10 October 2019 Woodside emailed APPEA advising of the proposed activity (**Appendix F**, reference 1.1) and provided a consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed APPEA providing information on repurposing the RTM (**Appendix F**, reference 2.1) and a Consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
CFA	On 2 July 2020, Woodside emailed CFA providing information on repurposing the RTM (**Appendix F**, reference 2.10) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Email, Consultation Information Sheet and Commonwealth fisheries map provided. Woodside considers the level of consultation to be adequate.
PPA	On 10 October 2019 Woodside emailed PPA advising of the proposed activity and potential implications and mitigation and management measures for fishers (**Appendix F**, reference 1.1) and provided a State Fisheries map relevant to the proposed activity and a consultation Information Sheet.	No feedback received.	Email, State Fisheries map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed PPA providing information on repurposing the RTM (**Appendix F**, reference 2.5) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback received.	Email, State Fisheries map and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
	On 6 July 2020, Woodside emailed PPA noting the Environment Plan will be submitted to NOPSEMA and not DMIRS (**Appendix F**, reference 2.6).		

Stakeholder	Information provided	Stakeholder response	Woodside response
Recfishwest	On 4 November 2019 Woodside emailed Recfishwest advising of the proposed activity (**Appendix F**, reference 1.20) and a consultation Information Sheet.	No feedback received.	Woodside to re-consult Recfishwest to seek and consider feedback for this Environment Plan.
	On 4 December 2019 Woodside re-sent consultation email to Recfishwest (**Appendix F**, reference 1.21).	On 18 December 2019 Recfishwest emailed Woodside advising they are seeking to develop an integrated artificial reef in the Exmouth region for the benefit of the local community and recreational fishing in WA. Recfishwest has undertaken preliminary consultation with key stakeholders in Exmouth who are either supportive of the proposal or have not raised concerns. A site survey campaign in January 2020 identified a suitable site for an artificial reef considering bathymetry, the benthic habitat and existing fish populations. Preliminary results from an independent assessment commissioned by Recfishwest on the risk to the marine environment posed by the RTM and its associated materials have all been classified as low.	Woodside will continue to engage Recfishwest throughout the EP activity.
	On 2 July 2020, Woodside emailed Recfishwest providing information on repurposing the RTM (**Appendix F**, reference 2.1) and a Consultation Information Sheet.	Woodside and Recfishwest ongoing discussions as part of the artificial reef permit and EP.	
Marine Tourism Association of WA	On 2 July 2020, Woodside emailed Marine Tourism Association of WA providing information on repurposing the RTM (**Appendix F**, reference 2.1) and a Consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside has consulted Recfishwest, and individual relevant charter operators. Woodside considers the level of consultation to be adequate.
WA Game Fishing Association	On 6 July 2020, Woodside emailed the WA Game Fishing Association providing information on repurposing the RTM (**Appendix F**, reference 2.1) and a Consultation Information Sheet.	On 20 July 2020, the WA Game Fishing Association wrote to Woodside providing support for the proposed reef given any improvements in recreational fishing opportunities will deliver social and economic benefits to the Exmouth community.	Woodside notes the feedback provided.
WAFIC	On 10 October 2019, Woodside emailed WAFIC advising of the proposed activity and potential implications and mitigation and	On 11 October 2019 WAFIC emailed Woodside advising its relevant officer was on leave and would review Woodside information upon return.	On 15 October 2019, Woodside emailed WAFIC advising it would circulate

Stakeholder	Information provided	Stakeholder response	Woodside response
	management measures for fishers (**Appendix F**, reference 1.1), and provided a State Fisheries map relevant to the proposed activity (**Appendix F**, reference 1.4) and a consultation Information Sheet.		consultation information to Pilbara Line Fishery Licence holders.
	On 21 October 2019, Woodside emailed WAFIC advising it would extend WAFIC's review of consultation information until 24 October 2019, with information to be sent to licence holders on 25 October.	On 21 October 2019 WAFIC emailed Woodside advising its relevant officer would not be returning from leave until 30 October 2019.	On 24 October 2019, Woodside advised it would send information to licence holders by 25 October 2019 to allow sufficient time for review and provision of feedback, prior to Woodside submitting the Environment Plan to NOPSEMA.
	On 12 November 2019, Woodside left a voicemail to discuss the activity.	On 14 November 2019, WAFIC left Woodside a voicemail following up.	Woodside to call back WAFIC.
	On 15 November 2019, Woodside called WAFIC to discuss the activity.	WAFIC advised Woodside should consult Pilbara Line Fishers.	Woodside has emailed Pilbara Line Fishers advising of the proposed activity, and provided the consultation Information Sheet and fisheries map.
		On 20 November 2019, WAFIC emailed Woodside advising the water depth is in the range fished by Pilbara Line fishers. It is keen to understand the fishing potential of the area, asking if a site map or footage is available. Requested Pilbara Line fishers be advised once the 500 m radius exclusion zone is removed. Requested clarity – the operational areas are not exclusion zones.	On 2 December 2019, Woodside confirmed by email that it had consulted Pilbara Line fishers. Woodside advised that fish aggregations may disperse as infrastructure is removed from the area and that Pilbara Lines fishers currently had access to fish in the area. Woodside will advise Pilbara Line fishers once exclusion zones for activities have been removed. Woodside will also issue a notification to mariners and request the AHO update navigation charts for both the removal of the RTM 500 m exclusion zone, and for the temporary MODU / Intervention Vessel 500 m exclusion zone. Woodside provided advice to WAFIC on definitions for Operational Areas.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 30 June 2020, Woodside called WAFIC to note it would be providing information on repurposing the RTM.	WAFIC noted it would receive the information and would provide a response.	Woodside will await WAFIC's feedback.
	On 2 July 2020, Woodside emailed WAFIC providing information on repurposing the RTM (**Appendix F**, reference 2.4) and provided a Commercial Fisheries map (**Appendix F**, reference 2.12) and a Consultation Information Sheet.	No feedback provided.	Woodside to continue to consult WAFIC.
	On 15 July 2020, Woodside called WAFIC and agreed to WAFIC reviewing the consultation material under fee-for-service.	On 15 July 2020, WAFIC emailed Woodside outlining the agreed fee-for-service arrangement. WAFIC requested a map showing the EMBA to consider fisheries overlap.	On 16 July 2020, Woodside called WAFIC and noted a map showing the EMBA is in the EP. WAFIC asked if there would be an EMBA associated with a potential oil spill associated with a well. Woodside advised not for this activity. Based on this WAFIC advised no further action to provide a map is required.
		On 15 July 2020, WAFIC sent an additional email to Woodside with its suggested comments on the consultation materials (under fee-for service): • Revision to the framing of the words in the cover email to fishing licence holders • Request individual maps were on their own separate 'tiles' rather than multiple fisheries on one map and to include bathymetry lines, and distance to shore. • Requested the information sheet be provided in Microsoft Word format. • Noted that the marine aquarium and specimen shell fisheries overlap the proposed reef site; however, based on their fishing methods these fisheries are not relevant. • The Developmental Octopus fisheries should be consulted as an exemption was granted after the initial consultation.	On 16 July 2020, Woodside called WAFIC to discuss the suggested comments: • Noted the framing of the words in the cover email to licence holders can also be used in future EP consultation. • Future maps would be updated to have individual fisheries on each tile and that bathymetry lines, and distance to shore can be included. • Advised based on Fisheries Research and Development Corporation (FRDC) and DPIRD reports that octopus are not located at the water depth of the proposed reef or deepwater disposal sites (only to 70 m). Based on DPIRD maps the fishery does not overlap the proposed activities.

Stakeholder	Information provided	Stakeholder response	Woodside response
			• WAFIC noted that the initial consultation materials sent to licence holders, prior to WAFIC review, did not need to be sent again. WAFIC also noted octopus are not located at the depths of the reef or deepwater disposal sites. WAFIC advised that the phone conversation addressed the comments raised, consultation materials had already been sent to relevant fishers, and no further consultation or written response was required.
Other stakeholders			
Exmouth-based charter boat, tourism and dive operators	On 10 October 2019 Woodside emailed stakeholders advising of the proposed activity (**Appendix F**, reference 1.14) and provided a consultation Information Sheet	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed stakeholders providing information on repurposing the RTM (**Appendix F**, reference 2.1) and a Consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate. Woodside has consulted the ECCI, which represents a number of charter operators through its membership.
Cape Conservation Group (CCG)	On 10 October 2019, Woodside email the Exmouth Community Reference Group advising of the proposed activity (**Appendix F**, reference 1.11) and provided a consultation Information Sheet.	On 9 October 2019, the Cape Conservation Group as member of the Exmouth Community Reference Group emailed Woodside seeking clarification on: • Whether consultation was just about the riser turret mooring removal and temporary plug installations. • Whether the permanent abandonment of the wells and infrastructure still in the field will have future consultation and a separate EP. • The difference between what is in place now for the wells, the temporary plug installation and the permanent plug installation.	• On 15 October 2019, Woodside emailed the Cape Conservation Group with the following responses: • Woodside confirmed it was seeking stakeholder feedback on the removal of the riser turret mooring, and well intervention in preparation for permanent plugging of the existing 18 wells. • Woodside confirmed that Environment Plan(s) and consultation will be conducted as part of the permanent abandonment of the wells

Stakeholder	Information provided	Stakeholder response	Woodside response
		• Whether the 10–20 days well intervention activities were for installation of temporary plugs or for permanent abandonment. • Whether there is increased difficulty of retrieval with items laid on the sea floor. • Where the riser turret mooring will be moved to. • The 18 wells plus riser turret removal could be up to 390 days or would activities occur concurrently. • Associated use of Exmouth Gulf for this work, including an estimate of vessel numbers, type and frequency.	and infrastructure and that these activities will likely require more than one Environment Plan. • Woodside advised that the wells were shut-in, with the valves on the Xmas tree closed and leak tested. 'Temporary' plugs, which have a design life of 5–10 years, had been installed inside the well bore to enable the Xmas tree to be removed. The Xmas trees are required to be removed to enable permanent plugging activities to occur. Permanent plugging activities will involve re-establishing a rock to rock bond to enable the well to be abandoned. These plugs were typically cement. • Woodside confirmed that 10-20 days was required for installing temporary mechanical plugs into the well bore. • Woodside confirmed that laying items on the seafloor did not increase the difficulty of future removal and was a common industry practice. • Woodside advised that the future location of the riser turret mooring was still being determined and would be subject to a separate approval process and consultation with stakeholders. • Woodside confirmed that 390 days could be the maximum duration, with the expected total duration of the 18 wells around 180 days (estimated only). Up to 360 have been allowed for project scheduling requirements, metocean conditions, vessel/MODU availability, unforeseen

Stakeholder	Information provided	Stakeholder response	Woodside response
			circumstances and weather. Woodside also advised that well activities may not be undertaken in a single campaign. The wells and riser turret mooring removal may be undertaken concurrently, depending on the variables above. • Woodside advised that there may be some use of the Exmouth Gulf to mobilise and demobilise vessels for the activities. The frequency of use of Exmouth Gulf is to be determined in the months prior to the activities being undertaken. Any use will comply with Woodside's Exmouth Gulf Vessel Management Plan. Woodside advised it would provide further information once available.
	On 2 July 2020, Woodside emailed the CCG providing information on repurposing the RTM (**Appendix F**, reference 2.30) and a Consultation Information Sheet.	No stakeholder response.	Woodside to continue to consult the CCG.
	On 16 July 2020, Woodside emailed the CCG asking if they would like to discuss the information provided (**Appendix F**, reference 2.39).	On 17 July 2020, the CCG emailed Woodside asking a range of questions: • The distance of the reef's closest edge from the Ningaloo Coast WHA • Were any contaminants found? • Seeking a definition of EHU. • The expected best and worst case scenario for the release of foam. • The expected best and worst case scenario for its release of plastic. • Any adverse environmental impacts from the hydraulic fluid • The expected containment life span of the aluminium and zinc anodes, and iron ore, and any implications from their release.	• On 22 July 2020, Woodside responded advising: • The closest edge would be around 650 m from the WHA; however, it could be as close as 300 m or as far away as 1 km. • No IMS were identified. • There are no other contaminants, all contaminants of the RTM are those presented in the information sheet. • A subsea EHU is a bundle of tubes and cables that provide fluids, electrical power and communication paths to and from a subsea production system.

Stakeholder	Information provided	Stakeholder response	Woodside response
		• Once in place, who is responsible for any environmental impacts. • Does the EP include monitoring for IMS, contaminants, foam release, plastic containment, hydraulic fluid release, aluminium and zinc anodes, and iron ore release, and, environmental impacts. • The minimum length of time the reef will be monitored and frequency. • Who is responsible for monitoring beyond the minimum monitoring time frame. • In the event of change is there a management/response plan.	• The foam will be compressed by the pressure at depth. Grout will then be used to fill the resulting void space. The intent is to fully encase the foam in grout to prevent release to marine environment. The steel shell of the RTM will provide additional separation and any degradation is likely to occur slowly over a long time frame, during which the reef will develop and establish marine growth. An assessment of the potential impacts and risks of release of the foam can be provided to the CCG. • The risers and EHUs will be isolated from the marine environment via either grout or the steel RTM shell. Any degradation of the grout or corrosion of the steel hull is likely to occur slowly over long time frames. An assessment of the potential impacts and risks of release of plastics from the risers and EHUs is can be provided to CCG. • The 50 L of hydraulic fluid is contained within individual ballast pipework which will corrode over hundreds of years. No credible scenarios have been identified where every pipe would corrode and rupture and the 50 L released instantaneously. • Aluminium and zinc anodes will corrode over time and have about another 5 years design life. Aluminium and zinc are natural elements found in the marine environment. They are inert and are not known to bio-accumulate, or affect sediment quality.

Stakeholder	Information provided	Stakeholder response	Woodside response
			• The iron ore is expected to have consolidated into a single mass. This will be exposed to the marine environment slowly over hundreds of years with no negative environmental impacts predicted. • Ownership of the reef transfers to the State Government. Recfishwest, as the permit applicant, is responsible for monitoring the reef over the 30-year monitoring period. • Visual inspections conducted throughout the monitoring period and any suspected identification of IMS will be reported to DPIRD. • Visual inspections conducted throughout the monitoring period will inspect the areas where control methods have been implemented to ensure foam and plastics are contained. • No specific monitoring is proposed for the hydraulic fluid or iron ore. However, as part of routine inspections conducted throughout the monitoring period, any noticeable releases of hydraulic fluid will be reported to the relevant government department. • As part of routine inspections any noticeable impacts from sacrificial anodes will be reported to the relevant government department. • Adverse environmental impacts undermine the purpose of artificial reefs, which is to provide healthy marine habitats for the purposes of recreational fishing.

Stakeholder	Information provided	Stakeholder response	Woodside response
			• Care has been taken to ensure that the artificial reef does not result in detrimental environmental outcomes, through contaminants or any aspect of placement. • Throughout the monitoring period, the artificial reef will be inspected to monitor the ecological progression of the area and identify any potential environmental impacts. • The proposed LTMP and rationale is subject to assessment by DAWE. • As part of the artificial reef permit application, Recfishwest have created a monitoring plan for the reef, which details the monitoring requirements and frequency. • The requirements for monitoring beyond the specified time frame will be determined by an assessment at the end of the monitoring period. • If changes relating to any of the above items are identified, these will be reported to the relevant government department. Subsequently, assessment of the identified changes will determine the management and response required.
		On 23 July 2020, the CCG wrote to Woodside and raised these points: • It considers oil and gas installations should be removed and brought onshore at the end of their life (as per NOPSEMA guidance). • Decommissioning should be considered in a field management plan. • Hydraulic fluid, foam and plastics will be dispersed into the environment and that, based on this,	On 24 July 2020, Woodside thanked the CCG for its feedback and noted it would consider the issues raised and respond. Woodside offered to meet in Exmouth to discuss the issues raised by the CCG. On 29 July 2020, Woodside emailed the CCG following up to see if it would like to meet, and do a 'page turn' of the EP.

Stakeholder	Information provided	Stakeholder response	Woodside response
		repurposing of the RTM is not expected to have equal or better environmental outcomes when compared to removal. • Maintenance of the RTM (and other infrastructure) is Woodside's responsibility. • Environmental criteria must also be considered in addition to socio-economic benefits, technical and financial factors. • There is no evidence of the marine benefits of the equipment supporting marine growth and habitat. • If the equipment is left in place or repurposed, ongoing monitoring and liability for the repurposed equipment should rest with the titleholder in perpetuity. • Woodside should be responsible for the repurposed equipment if left in place and its impacts and monitoring. On 31 July 2020, the CCG emailed Woodside thanking it for the offer to meet. The CCG noted: • It supports section 572 of the legislation. • Any divestment of infrastructure that places environmental safety in a secondary position will not be acceptable from CCG's perspective • While there may be limited instances where some equipment is acceptable for repurposing for recreational fishing uses, this possibility can never become the starting point or default position for decommissioning • CCG's focus is on defending the broader public interest in preventing the leaching of pollutants into the marine environment. • Decommissioning of oil and gas structures may, in exceptional circumstances, not be straightforward.	On 5 August 2020, Woodside responded and noted: • Woodside takes responsibility of the full lifecycle of our activities, through to decommissioning. • Decommissioning activities include timely and effective planning, obtaining necessary approvals, and executing activities in compliance with the OPGGS Act and regulations. • The Act allows for alternative arrangements (other than complete removal). • An assessment of the potential impacts of release of the hydraulic fluid will be included in the EP. • We are undertaking a further assessment on the option to remove the risers and EHU. A full assessment of the impacts of the risers should they be left within the RTM, will be included in the EP. • We have investigated physically removing the foam, however due to the location and no access hatch into the compartment, this is not considered practicable. • We provided an overview on the assessment of the grout and foam. • Decommissioning activities are conducted under the OPGGS Act and regulations, providing legal and process certainity to all stakeholders and ensuring risks are managemend effectively. It provides a structure for titleholders seeking to vacate a title area.

Stakeholder	Information provided	Stakeholder response	Woodside response
			• The definition of 'environment' in the Regulations includes social, economic, and cultural features. • The artificial reef option provides socio-economic benefits and environmental benefits such as habitat creation, outweighing the benefits of complete removal.
		On 6 August 2020, the CCG: • Advised it does not have a lack of interest in meeting Woodside. • Notes operators must demonstrate that leaving the equipment in place results in an equal or better environmental outcome. • Woodside has chosen a narrow definition of 'environment' from section 4 of the Regulations • Notes socio-economic benefits can play a part in environmental outcomes, however fails to address any genuine environmental criteria which include direct, indirect, spatial and temporal impacts. • Seeks an understanding of how leaving the equipment in place results in an equal or better environmental outcome.	On 24 August 2020, Woodside emailed the CCG: • Noted the CCG does not have a lack of interest in meeting. • Noted direct, indirect, spatial and temporal impacts will be considered. • Woodside agrees this criteria should be considered when assessment environmental impacts and confirm that the impacts are considered in the Environment Plan. • The CCG feedback has been considered and will be included in the revised EP. • The revised EP would be available on the NOPSEMA website.
			Woodside will further review the CCG comments and provide a further response to the CCG based on the revised published EP.
Protect Ningaloo	On 2 July 2020, Woodside emailed Protect Ningaloo providing information on repurposing the RTM (**Appendix F**, reference 2.31) and a Consultation Information Sheet.	No feedback received.	Woodside to follow up with Protect Ningaloo.
	On 16 July 2020, Woodside emailed Protect Ningaloo asking if they like to discuss the information provided (**Appendix F**, reference 2.40).	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
Exmouth Community Reference Group	On 9 October 2019, Woodside emailed the Exmouth Community Reference Group advising of the proposed activity (**Appendix F**, reference 1.11) and provided a consultation Information Sheet	On 10 October 2019, the Cape Conservation Group emailed Woodside if the information provided was the same as that it had received previously and whether Woodside had received its emailed response and questions. Feedback received from Cape Conservation Group outlined above in this table.	On 15 October 2019, Woodside emailed the Cape Conservation Group apologising for sending the material twice – as member of the Exmouth Community Reference Group and as an individual stakeholder. Woodside confirmed it would respond to questions from the Cape Conservation Group.
	The proposed activity was an agenda item at a Community Reference Group meeting on 7 November 2019. A presentation slide and advising of proposed activity (**Appendix F**, reference 1.12) and a consultation Information Sheet were provided.	No feedback was provided.	Woodside presentation including information on the activity was sent to the Reference Group on 19 November 2019.
	The proposed activity was an agenda item at a Community Reference Group meeting on 12 March 2020. A presentation slide was provided advising of proposed activity (**Appendix F**, reference 2.18).	No feedback was provided.	Woodside presentation including information on the activity was sent to the Reference Group on 16 May 2020.
	On 2 July 2020, Woodside emailed the Community Reference Group providing information on repurposing the RTM (**Appendix F**, reference 2.19) and a Consultation Information Sheet.	On 16 July 2020, a member of the Community Reference Group emailed Woodside advising the reef is a great initiative.	Woodside notes the feedback provided.
		On 22 July 2020, Base Marine (member of the Community Reference Group) wrote to Woodside providing a letter of support for the proposed reef, creating local jobs, and additional support to local businesses.	Woodside notes the feedback provided.
	The proposed activity was an agenda item at a Community Reference Group meeting on 7 September 2020. A presentation slide was provided advising of proposed activity (**Appendix F**, reference 2.33).	No feedback was provided.	Woodside presentation including information on the activity will be sent to the Reference Group.
Exmouth Game Fishing Club	On 10 October 2019, Woodside emailed the Exmouth Game Fishing Club advising of the proposed activity (**Appendix F**, reference 1.13) and a consultation Information Sheet was provided.	No feedback received.	Woodside to re-consult the Game Fishing Club.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 1 November 2019 Woodside sent a follow-up email seeking stakeholder feedback.	No feedback received.	Woodside has also consulted Recfishwest and Charter Operators and considers the level of consultation to be adequate.
	On 2 July 2020, Woodside emailed the Exmouth Game Fishing Club providing information on repurposing the RTM (**Appendix F**, reference 2.20) and a Consultation Information Sheet.	On 22 July 2020, the Exmouth Game Fishing Club wrote to Woodside providing a letter of support for the proposed reef. The club noted it supports environmentally appropriate oil and gas infrastructure being used as artificial reefs. It noted it had identified the location of the proposed reef through the stakeholder consultation process with Recfishwest on the reef permit.	Woodside notes the feedback provided by the Club, and that consultation undertaken by Recfishwest to identify a suitable location for the reef.
ECCI	On 2 July 2020, Woodside emailed ECCI providing information on repurposing the RTM (**Appendix F**, reference 2.21) and a Consultation Information Sheet.	No feedback provided.	Woodside to continue to consult.
	On 16 July 2020, Woodside emailed ECCI asking if they like to discuss the information provided (**Appendix F**, reference 2.35).	On 21 July 2020, ECCI emailed Woodside noting it supports the EP.	On 21 July 2020, Woodside called ECCI to clarify that ECCI supported the IAR proposal. ECCI clarified it supported the reef proposal.
Shire of Exmouth	On 2 July 2020, Woodside emailed the Shire of Exmouth providing information on repurposing the RTM (**Appendix F**, reference 2.22) and a Consultation Information Sheet.	No feedback provided.	Woodside to continue to consult.
	On 16 July 2020, Woodside emailed the Shire asking if they like to discuss the information provided (**Appendix F**, reference 2.36).	On 17 July 2020, the Shire thanked Woodside for the opportunity to provide comment and noted the Council supports the initiative, provides a way to repurpose rather than disposal, provides other opportunities like new dive sites, and would be a good news story.	Woodside notes the Shire’s feedback.
		On 20 July 2020, the Shire emailed that if further infrastructure becomes available for decommissioning consideration to repurposing be given to suit divers and snorkellers, and that the depth of the reef is 150 m.	Woodside will consider this response for future decommissioning.
	On 2 July 2020, Woodside emailed the Ningaloo Coast World Heritage Advisory Committee providing information on	No feedback provided.	Woodside to continue to consult.

Stakeholder	Information provided	Stakeholder response	Woodside response
Ningaloo Coast World Heritage Advisory Committee	repurposing the RTM (**Appendix F**, reference 2.29) and a Consultation Information Sheet.		
	On 16 July 2020, Woodside emailed the Committee asking if they like to discuss the information provided (**Appendix F**, reference 2.38).	On 21 July 2020, the Committee Program Manager advised the Committee is reviewing the proposal to repurpose the RTM as an artificial reef and would respond by 24 July.	Woodside will await the Committee's response.
		On 24 July 2020, the Committee responded and raised the following points: • In principle the Committee does not support repurposing the infrastructure near a WHA given concerns to potential impacts. • Recommends the relocation of the reef further from the WHA boundary. • Preference that decommissioned structures are removed onshore. • Notes the residual contaminants with the RTM and potential for release into the water. • Notes there is no information on cumulative impacts of other vessels, platforms or monopod structures in the area. • How the structure will be stabilised on the seabed and the potential for the reef to shift location nearer to the WHA. • The detraction of fish species from the WHA.	On 27 July 2020, Woodside responded thanking the Committee for its response, noting it would consider the issues raised and respond. Woodside also offered a meeting to discuss the issues raised.
			On 5 August 2020, Woodside responded to the Committee: • The activity must not contravene the values and objectives set out for any sensitive feature of the environment proclaimed under the EPBC Act, including for AMPs and WHPs. • The proposed reef location was selected after multiple rounds of consultation by Recfishwest, and site survey at the location. • The site survey found the proposed site was a featureless seafloor, with no surrounding reef structure, less than 1% sessile filter feeding organisms, and suitable and safe for a new artificial reef. • A constraints mapping process helped to ensure the proposed location is compatible with the purpose of the artificial reef, as well as considering its suitability based on other issues such as location of marine protected areas etc.

Stakeholder	Information provided	Stakeholder response	Woodside response
			• The nearest hard coral communities are located at least 11 km from the proposed reef site. • The revision of the EP, and artificial reef permit application includes a description of any residual contaminants within the RTM structure, and an assessment of the potential environmental impacts and risks of release of these materials over time. • King Reef in the Exmouth Gulf is the only other artificial reef in the region of the proposed reef; however, it provides a different habitat for marine life and is in substantially shallower water • A detailed hydrodynamic analysis of the RTM and reef modules found the reef will remain stable in a 1-in-10,000 year cyclonic wave event. • Through this analysis and the self-weight of the RTM and design of the reef modules, once ballasted on the seafllor, the RTM wont slide or roll. • Many species are unlikely to migrate to the new habitat provided by an artificial reef. • Small bodied, reef obligate specieis are typically less likely to traverse large sandy expanses to reach an artificial reef, whereas reef-associated pelagic species may travel large distances and aggregate around an artificial reef. • Attraction of fish to the artificial reef is expected to be dominated by fast-growing pelagic species, and low

Stakeholder	Information provided	Stakeholder response	Woodside response
			numbers of demersal reef-associated species.
			On 24 August 2020, Woodside emailed the Committee advising the resubmitted EP will be public on the NOPSEMA website, and that Woodside is still happy to meet to discuss the Committee's feedback.
Nganhurra Thanardi Garrbu Aboriginal Corporation	On 6 July 2020, Woodside emailed the Nganhurra Thanardi Garrbu Aboriginal Corporation providing information on repurposing the RTM (**Appendix F**, reference 2.32) and a Consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Exmouth community and visitors	On 17 October 2019 the consultation Information sheet placed on community oil and gas noticeboard (**Appendix F**, reference 1.2)	No feedback received.	Woodside has consulted the Exmouth Community Reference Group and considers this level of consultation as appropriate.
	On 7 July 2020 the consultation Information Sheet placed on the community oil and noticeboard (**Appendix F**, reference 2.2)	No feedback received.	Woodside has consulted the Exmouth Community Reference Group and considers this level of consultation to be adequate.

5.6 Artificial Reef Permit: Recfishwest Consultation – Overview

Recfishwest consulted Government agencies and the community (from August 2019 to July 2020) as part of the Sea Dumping Permit for the proposed IAR.

A stakeholder engagement framework was established to underpin the stages of engagement with various relevant regulatory authorities, with these objectives:

1. Ensure relevant authorities are provided with sufficient information to allow them to make an informed assessment, and provide adequate opportunity to consider and provide feedback.
2. Provide a mechanism for assessing the merit of any objections or claims received.
3. Demonstrate that control measures (where applicable) have been adopted as a result of the outcome of consultation.
4. Support and record ongoing stakeholder identification, engagement and consultation.

Recfishwest identified and consulted the following relevant stakeholders to meet the requirements of the Sea Dumping Act:

Relevant State and Commonwealth Authorities	
State	***Commonwealth***
Department of Biodiversity, Conservation and Attractions	Australian Fisheries Management Authority
Department of Jobs, Tourism, Science and Innovation	Australian Hydrographic Service
Department of Mines, Industry Regulation and Safety	Australian Maritime Safety Authority
Department of Planning, Lands and Heritage	National Offshore Petroleum Safety and Environmental Management Authority
Department of Primary Industries and Regional Development	National Offshore Petroleum Titles Administrator
Department of Transport	Royal Australian Navy Submarine Service
Other Stakeholders	
Commonwealth Fisheries Association	Tourism WA
Gascoyne Development Commission	Tuna Australia
Nganhurra Thanardi Garrbu Aboriginal Corporation	Western Australian Fishing Industry Council
Shire of Exmouth	

Recfishwest also consulted community stakeholders including committee members from the Exmouth Game Fishing Club, tackle store owners and managers, charter operators, recreational fishing research volunteers, avid fishers and representatives from both the Exmouth Marine Rescue Group and Shire of Exmouth.

Consultation information provided to community stakeholders included:

- An overview of the opportunity for an artificial reef
- Repurposed oil and gas infrastructure will be used
- The reef would be larger than King Reef in the Exmouth Gulf
- The reef would be in water depths greater than 80 m
- Located north of North West Cape.

5.6.1 Outcomes of Consultation

Relevant State and Commonwealth agencies were either supportive or raised no objections to the proposed location, concept or permitting process for the IAR. Community stakeholders were overwhelmingly supportive of the IAR including repurposing oil and gas infrastructure, IAR location, and water depth.

Ongoing consultation will occur with stakeholders throughout the duration of the artificial reef permit application. If any objection of claim is received, Recfishwest will assess the merit of the objection or claim provided by the relevant person and, where deemed necessary, will implement additional control measures to ensure all impacts and risks continue to be reduced to ALARP and are acceptable.

5.7 Ongoing Stakeholder Consultation

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

Table 5-3: Assessment of ongoing stakeholder consultation

Stakeholder	Activity
AMSA	Woodside will notify AMSA’s JRCC at least 24–48 hours before operations commence.
AHO	Woodside will notify the AHO no less than four working weeks before operations commence.

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

6.1 Overview

This section presents the risk analysis, risk evaluation and environment performance outcomes, environmental performance standards and measurement criteria for the Petroleum Activities Program, using the methodology described in **Section 2** of the EP.

6.2 Risk Analysis and Evaluation

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

The risks identified during the ENVID workshop (including decision type, current risk level, acceptability of risk and tools used in the demonstration of acceptability and ALARP) have been divided into two broad categories: planned (routine and non-routine); and unplanned events (accidents, incidents or emergency situations). Within these categories, impact assessment groupings are based on stressor type, e.g. emissions, physical presence. In all cases, the worst-case risk was assumed.

The ENVID (undertaken in accordance with the methodology described in **Section 2.3**) identified 25 sources of environmental risk, comprising 15 planned, which are all assessed as having a low current risk rating, and nine unplanned sources of risk, which are assessed as having a low to high current risk rating following the implementation of identified preventative and mitigation control measures. Planned activities and unplanned events are summarised in **Table 6-1** and

Table 6-2.

The risk analysis and evaluation for the Petroleum Activities Program indicate that all of the current environmental risks and impacts associated with the activity are reduced to ALARP and are of an acceptable level as discussed further in **Sections 6.6** and **6.6.2**.

6.2.1 Cumulative Impacts

Given the presence of operating FPSOs in the vicinity of the NGA facility (**Section 4.5.6**), the cessation of operations of the NGA facility may have reduced cumulative impacts that could arise from the operation of facilities in the region, such as routine, non-routine and accidental discharges from FPSOs, offtake tankers and support vessels.

Woodside may undertake opportunistic well interventions during the Petroleum Activities Program. However, these are short-term activities with minimal discharges.

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

Aspect	Operational Area	EP Section	Impact/Consequence		Acceptability of Impact
			Impact/consequence level	Potential impact/consequence[1]	
Planned Activities (Routine and Non-routine)					
Physical presence: interactions with other marine users	Operational Area 1	6.6.1.1	F–E	Social and Cultural – Slight, short-term impact (<1 year) to a community or areas/items of cultural significance	Broadly acceptable
	Operational Area 2	6.7.1.1	Beneficial impact–F	Social and Cultural – No lasting effect (<1 month) or negligible impact. Localised impact not significant to area/item of cultural significance	Broadly acceptable
Physical presence: disturbance to seabed	Operational Area 1	6.6.1.2	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
	Operational Area 2	6.7.1.2	Beneficial impact–F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
Routine and non-routine discharges: long-term degradation and corrosion of the RTM and reef modules	Operational Area 2	6.7.1.3	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
Routine discharges: project vessel operations	Operational Area 1	6.6.1.3	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
	Operational Area 2	6.7.1.4			
Routine and non-routine discharges: hydrocarbons, chemicals and well intervention fluids	Operational Area 1	6.6.1.4	F–E	Environment – Slight, short term local impact (<1 year), on species, habitat (but not affecting ecosystem function), physical or biological attributes	Broadly acceptable
Routine and non-routine discharges: hydrocarbons and chemicals from removal of risers, and excess grout from foam and bend stiffener encapsulation	Operational Area 2	6.7.1.5	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
Routine light emissions	Operational Area 1	6.6.1.5	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
	Operational Area 2	6.7.1.6	E	Environment – Slight, short term local impact (<1 year), on species, habitat (but not affecting ecosystem function), physical or biological attributes	Broadly acceptable
Routine acoustic emissions	Operational Area 1	6.6.1.6	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
	Operational Area 2	6.7.1.7			
Routine and non-routine atmospheric emissions	Operational Area 1	6.6.1.7	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	Broadly acceptable
	Operational Area 2	6.7.1.8			

[1] *Where impact has multiple consequence rankings, the highest consequence has been described.*

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

Aspect	Operational Area	EP Section	Current Risk Rating				Acceptability of Risk
			Consequence Classification	Potential Consequence level of impact[1]	Likelihood	Risk Rating	
Unplanned Events (Accidents/Incidents)							
Unplanned hydrocarbon release: loss of well containment during intervention activities	Operational Area 1	6.6.2.2	B	Environment – Major, long-term impact on highly values ecosystems, species, habitats or physical or biological attributes Reputation and Brand – National concern and/or international interest. Medium to long-term impact to reputation and brand. Venture and/or asset operations restricted Social and Cultural – Major, long-term impact to a community, social infrastructure or highly valued areas/ items of national cultural significance	2	H	Acceptable
Unplanned hydrocarbon release: loss of well containment due to accidental damage to, or removal of, Xmas tree during well intervention activities	Operational Area 1	6.6.2.3	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes Social and Cultural – Minor, short-term impact (1–2 years) to a community or highly valued areas/items of cultural significance	0	L	Broadly acceptable
Unplanned hydrocarbon release: vessel collision	Operational Area 1	6.6.2.4	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes Social and Cultural – Minor, short-term impact (1–2 years) to a community or highly valued areas/items of cultural significance	1	M	Broadly acceptable
	Operational Area 2	6.7.2.2					
Unplanned hydrocarbon release: bunkering	Operational Area 1	6.6.2.5	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	3	M	Broadly acceptable
Unplanned discharge: release of plastics	Operational Area 2	6.7.2.1	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	1	L	Broadly acceptable
Unplanned discharges: loss of chemicals / hydrocarbons from project vessels	Operational Area 1	6.6.2.6	F-E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	2	M	Broadly acceptable
Unplanned discharges: loss of chemicals / hydrocarbons from project vessels and grout during foam and bend stiffener encapsulation	Operational Area 2	6.7.2.3					
Unplanned discharges: loss of solid hazardous / Non-hazardous wastes	Operational Area 1	6.6.2.7	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	2	L	Broadly acceptable
	Operational Area 2	6.7.2.4					
Physical presence: vessel collision with marine fauna	Operational Area 1	6.6.2.8	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	1	L	Broadly acceptable
	Operational Area 2	6.7.2.5					
Physical presence: disturbance to seabed from dropped objects or dragged subsea equipment	Operational Area 1	6.6.2.9	F	Environment – No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors	1	L	Broadly acceptable
Physical presence: disturbance to seabed from dropped objects	Operational Area 2	6.7.2.6	F–D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes Social and Cultural – Minor, short-term impact (1–2 years) to a community or highly valued areas/items of cultural significance	0-2	L	Broadly acceptable
Physical presence: accidental introduction of IMS	Operational Area 1	6.6.2.10	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes	0	L	Broadly acceptable
	Operational Area 2	6.7.2.7	B	Environment – Major, long-term impact on highly values ecosystems, species, habitats or physical or biological attributes Social and Cultural – Major, long-term impact to a community, social infrastructure or highly valued areas/ items of national cultural significance	0	M	Broadly acceptable

[1] Where risk has multiple consequence rankings, the highest consequence has been described.

6.3 Environmental Performance Outcomes, Standards, and Measurement Criteria

Regulation 13(7) of the Environment Regulations requires that an EP includes environmental performance outcomes, environmental performance standards and measurement criteria that address legislative and other controls to manage the environmental risks of the activity to ALARP and Acceptable levels.

Environmental performance outcomes, standards and measurement criteria for the Petroleum Activity Program have been identified to allow the measurement of Woodside's environmental performance and the implementation of this EP to determine whether the environmental performance outcomes and standards have been met.

The environmental performance outcomes, standards and measurement criteria specified are consistent with legislative requirements and Woodside's standards and procedures. They have been developed based on the Codes and Standards, Good Industry Practices and Professional Judgement outlined in **Section 2.6**, as part of the acceptability and ALARP justification process.

The environmental performance outcomes, environmental performance standards and measurement criteria are presented throughout this section and in **Appendix D** (Oil Spill Preparedness and Response). A breach of these environmental performance outcomes or standards, constitutes a 'Recordable Incident' under the Environment Regulations (refer to **Section 7.8.4**).

6.4 Presentation

The risk analysis and evaluation (ALARP and acceptability), environmental performance outcomes, standards and measurement criteria are presented in the following tabular form throughout this section. Italicised/green text in the following example table denotes the purpose of each part of the table with reference to the relevant sections of the Regulations and/or this EP.

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 Impact/Risk *Regulation 13(1)*	**Environmental Value Potentially Impacted** *Regulations 13(2)(3)*							**Evaluation** *Section 2.3*						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Summary of source of impact/risk														

Description of Source of Impact/Risk
Description of the identified risk including sources or threats that may lead to the risk or identified event. Regulation 13(1).

Impact Assessment
Environmental Value/s Potentially Impacted
Discussion and assessment of the potential impacts to the identified environment value/s. Regulation 13(5) (6). *Potential impacts to environmental values have been assigned and discussed based on Woodside's Environmental Consequence Definitions for Use in Environmental Risk Assessments (Table 2-3).*

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[6]	***Benefit in Impact/Risk Reduction***[7]	***Proportionality***	***Control Adopted***
ALARP Tool Used – Section 2.7				
Summary of control considered to ensure that 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)*	*Quantum of impact/risk that could be averted (measured in terms of reduction of likelihood, consequence and current risk rating) 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 # provided.*
ALARP Statement *Made on the basis of the environmental risk assessment outcomes, use of the relevant tools appropriate to the decision type (Section 2.7 and Figure 2-4) and a proportionality assessment. Regulation 10A (b).*				

[7] Measured in terms of reduction of likelihood (L), consequence (C) and current risk rating (CRR)

Demonstration of Acceptability
Acceptability Statement *Made on the basis of the application of the process described in Section 2.7 and Figure 2-4, taking into account internal and external expectations, risk to environmental thresholds and use of environment decision principles. Regulation 10A(c)*

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO# S: Specific performance which 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 by measuring implementation of the controls via the measurement criteria. 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 and the potentially impacted environmental value. T: The outcome will state the timeframe during which the outcome will apply or by which it will be achieved.	**C#** *Identified control adopted to ensure that the impacts and risks are continuously reduced to ALARP. Regulation 13(5) (c).*	**PS#** *Statement of the performance required of a control measure. Regulation 13(7)(a)*	**MC#** *Measurement criteria for determining whether the outcomes and standards have been met. Regulation 13(7)(c)*

6.5 Potential Environmental Risks not included within the Scope of the Environment Plan

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

6.5.1 Shallow/Nearshore Activities

The Petroleum Activities Program is located in waters about 400–600 m deep and about 33 km from nearest landfall (North West Cape). Consequently, risks associated with shallow/nearshore activities such as anchoring and vessel grounding were assessed as not credible.

6.5.2 Damage to Wellheads by Unknown Third Party

Potential impacts associated with commercial fishing and trawling activities are common to all petroleum activities in the NWMR. The main potential impact from the presence of subsea infrastructure, including wellheads and subsea Xmas trees, is a snagging hazard to benthic trawl fishers and exclusion of fishers from an area where infrastructure is present (**Section 6.5.2**). However, the risk of this occurring and resulting in a loss of well containment is not considered credible given trawl fishing activity is concentrated outside the Operational Area and that no trawl fishing has occurred within the Operational Area for at least the past five years (**Section 4.5.3** and

Table 5-1). The wells are also marked on nautical charts, which incorporate exclusion zones of 500 m around each well, and a cautionary zone of 2.5 nm (4.6 km) around the RTM. Entry to these zones is prohibited by NOPSEMA via a notice published in the Gazette, which states approaching vessels are not permitted to enter the exclusion zone without consent [https://www.nopsema.gov.au/assets/Gazettal-notices/A525363.pdf].

Given the water depths of the wellheads (495 to 550 m), damage to the wellheads from other third-party vessels (such as commercial shipping, tourism, other oil and gas activities or defence) is also not considered credible.

6.5.3 Loss of Hydrocarbons to the Marine Environment as a Result of Corrosion of a Wellhead / Xmas Tree

The loss of hydrocarbons to the marine environment as a result of corrosion of a wellhead / Xmas tree is not considered credible based on an extensive investigation and risk analysis of the Enfield well integrity, which was conducted in 2017 before production ceased. The investigation identified and assessed risks from the point of cessation of production through to abandonment activities. This review remains valid with identified risks, analysis and control measures still applicable.

In 2018 a further review into the corrosion risks as the wells approached cessation of production and suspension of well activities prior to abandonment was completed. The review concluded that while the wells were suspended (“static state”), corrosion advancement and loss of wall thickness to the 9⅝” and 13⅜” carbon steel casing would be limited due to the wells no longer flowing, and that the integrity of these barriers would retain design integrity requirements. Since this assessment was made, production has ceased and all subsea Xmas tree barriers have been closed and tested, including all production bore barriers and annulus bore barriers. All control line vents have also been closed. During the ROV inspections at cessation of production these vents were observed for leaks and all relevant vent isolations were closed, thus removing this risk.

The status of the wells is such that the risk of a loss of containment now is less than that during their operation phase.

6.6 Impact and Risk Assessment for Activities within Operational Area 1

6.6.1 Planned Activities (Routine and Non-routine)

6.6.1.1 Physical Presence: Interactions with Other Marine Users during Activities within Operational Area 1

Context		
RTM Activities – **Section 3.7** Well Intervention – **Section 3.9** Project Vessels – **Section 3.10** Helicopters – **Section 3.12**	Socio-economic and Cultural Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-economic*	*Decision Type*	*Consequence*	*ALARP Tools*	*Acceptability*	*Outcome*
Presence of project vessels causing interference with or displacement to third-party vessels (commercial shipping and commercial/ recreational fishing) within Operational Area 1							X	A	E	LCS GP PJ	Broadly acceptable	EPO 1, 2 and 3
Retention of RTM in situ prior to removal causing interference with or displacement to third party vessels (commercial shipping and commercial/ recreational fishing) within Operational Area 1							X	A	E			
Presence of subsea infrastructure within Operational Area 1 causing interference with or displacement to commercial fishing							X	A	F			
Proximity of helicopters causing interference with other aerial operations within Operational Area 1							X	A	F			

Description of Source of Impact

Presence of project vessels

In order to undertake well intervention, a MODU or intervention vessel will be on station above the wells within Operational Area 1. The number and type of well activities undertaken will be dependent on the availability of vessels and MODUs over the life of the EP. General well intervention activities are expected to require 10–20 days per well to complete.

Project vessels will support the Petroleum Activities Program throughout and will remain on standby to communicate with third-party vessels and assist in maintaining the safety exclusion zone. Indicative project vessels, numbers, and duration for the Petroleum Activities Program within Operational Area 1 are provided in **Table 6-3**. Timings of activities are provided in **Table 3-3**, **Table 3-21** and **Table 3-22**.

Table 6-3: Indicative durations of vessel-based activities during the Petroleum Activities Program

Activity	Vessels	Duration (days)
Well intervention	MODU Intervention vessel Anchor handling vessel Support vessels	Up to 360 (18 wells)
Inspection and maintenance	Support vessel	To be determined by risk-based inspection schedule
RTM removal (including potential IMMR activities)	PIV Anchor handling Vessel	30 days (with potential for a cumulative 90 days)

Helicopters

During petroleum activities within Operational Area 1, crew changes will be undertaken using helicopters as required.

Retention of RTM in situ prior to removal

The RTM is a floating, partially submerged structure that is maintained in position by mooring lines. The presence of the RTM within Operational Area 1 may present a navigational hazard to shipping and commercial fishing activities, resulting in displacement of third party vessels. The RTM is located within an established 500 m Petroleum Safety Zone and is clearly marked on current nautical charts.

While the FPSO was connected to the RTM during production operations, it was not uncommon for FPSO facilities to disconnect from RTM systems (e.g. to avoid cyclones, drydock for major repairs). As such, the need for other users to avoid the RTM when the FPSO is absent is not considered unusual.

The RTM is approximately 6 m above the sea surface and is coated in high visibility paint, as per good maritime practice for fixed hazards; warning lights are also fitted to the RTM. The outer casing of the RTM is constructed of steel and is reflective, resulting in a clear signal return for anti-collision radars fitted on-board commercial vessels. Additionally, a passive radar reflector is installed on the RTM to enhance the detectability of the RTM by shipboard radar.

Removal of RTM and tow from title area

The RTM will be disconnected from its mooring anchors and towed from Operational Area 1 and the title area. Impacts associated with the tow and other activities within Operational Area 2 are described in **Section 6.7.1.1**.

Presence of subsea infrastructure

Subsea infrastructure will be retained in situ in a preserved state (i.e. wells isolated, production system flushed of hydrocarbons, filled with preservation fluid at hydrostatic pressure). During removal of the RTM, the mooring lines will be disconnected from the RTM and lowered to the seabed in a controlled manner. These will remain in situ for future field decommissioning.

Impact Assessment

Potential impacts to environmental values

Interference with commercial shipping

The presence of project vessels and the RTM within Operational Area 1 could potentially cause temporary disruption to commercial shipping. Consultation with AMSA confirms that vessel traffic may be encountered within Operational Area 1. However, it is noted that no shipping fairways intersect Operational Area 1. The nearest shipping fairway designated by AMSA lies approximately 40 km north-west of Operational Area 1. Additionally, in the vicinity of Operational Area 1, vessel tracking data provided by AMSA indicate that the majority of traffic will be vessels associated with existing oil and gas infrastructure (**Section 4.5.6**).

There may be commercial vessels infrequently transiting through Operational Area 1. The use of the shipping fairways is strongly recommended by AMSA, but is not mandatory, and shipping vessels still have to adhere to the International Regulations for Preventing Collisions at Sea 1972, as implemented under Australian laws and regulations. The potential impacts could include short-term displacement of vessels as they make slight course alterations to avoid project vessels.

Displacement of commercial and recreational fishing activity

A number of Commonwealth and State managed fishery boundaries overlap the Operational Area (**Section 4.5.3**):

Commonwealth

- North West Slope Trawl Fishery

- Southern Bluefin Tuna Fishery
- Western Deepwater Trawl Fishery
- Western Skipjack Fishery
- Western Tuna and Billfish Fishery.

State

- Mackerel Managed Fishery
- South West Coast Salmon Managed Fishery
- West Coast Deep Sea Crustacean Managed Fishery
- Pilbara Crab Managed Fishery
- Pilbara Demersal Scalefish Fisheries
- West Australian Sea Cucumber Fishery.

This overlap of Operational Area 1 with commercial fishing activity may temporarily displace fishers from the area. Additionally, the presence of subsea infrastructure such as well heads, manifolds, flowlines and risers may present a snagging hazard to benthic trawls.

Of the fisheries managed areas that overlap Operational Area 1, there is potential for interaction with the PDSF, in particular the PLF, with DPIRD (Fish Cube, 2019) records showing activity within the 60 nm that covers Operational Area 1. Consultation in relation to the Petroleum Activities Program indicated no claims or objections were raised by participants in fisheries that overlap Operational Area 1. Additionally, the NGA Facility commenced operations in 2006, and the RTM remains marked on standard nautical charts. Given the period in which the facility had been in operation and the location being marked on nautical charts, commercial fishers are expected to be aware of the infrastructure. As such, potential impacts to commercial fishing activities within Operational Area 1 are considered to be localised displacement/avoidance by commercial trawling and line fishery vessels within the immediate vicinity of Operational Area 1. The potential impact is considered to be slight and of no lasting effect.

Recreational fishing and nature-based tourism in the region is concentrated in shallow coastal waters, particularly those in proximity to access nodes such as boat ramps. Recreational fishing effort in Operational Area 1 is expected to be minimal to nil, given the water depth (400–600 m), lack of reef habitat hosting sought-after demersal species, and distance offshore (47 km from Exmouth). Additionally, consultation in relation to the Petroleum Activities Program indicated no claims or objections were raised by recreational fishers. No tourism operators have been documented in Operational Area 1 since commencement of NGA operation in 2006. As such, no impacts to recreational fishing and tourism are expected during the Petroleum Activities Program.

Therefore, the potential impact to commercial and recreational fisheries is considered to be slight.

Interference with other aerial operations

Operational Area 1 is located within the northern tip of one of the designated defence practice areas of the Royal Australian Air Force base located at Learmonth (**Section 4.5.7**). While it is unlikely that helicopter activities from the petroleum activity program could interfere with defence activities, the use of helicopters to transfer crew has the potential to interact with defence activities, and therefore defence stakeholders were consulted (**Section 5**). No concerns were raised during the consultation process, and as such the potential impact is considered to be of no lasting effect.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that the physical presence of project vessels, helicopters and RTM will not result in a potential impact greater than isolated and short-term impact to shipping, commercial/recreational fishing, oil and gas interests, nature-base tourism, defence, or other aerial operations with a consequence of slight or lower.

Vessel-based activities for the Petroleum Activities Program will lead to a small increase in the overall vessel traffic in Operational Area 1. However, no cumulative impacts from the interference with or displacement of third party vessels are expected.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[8]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards				
Passive radar reflectors and navigation lights maintained on RTM.	F: Yes. CS: Minimal cost, standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice.	Yes C 1.1
500 m safety exclusion zone established around MODU / intervention vessel and RTM.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Controls based on legislative requirements – must be adopted.	Yes 2.1a
Good Practice				
Activity support vessel(s) on standby during well intervention activities to communicate with third-party vessels and assist in maintaining the safety exclusion zone.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Controls based on legislative requirements – must be adopted.	Yes 2.2a
Activity support vessel(s) assigned to surveillance will undertake the following actions: • Maintain a 24-hour radio watch on designated radio channel(s) • Undertake continuous surveillance and warn the MODU/ intervention vessel/ PIV (as required) of any approaching vessels reaching 500 m safety exclusion zone. Surveillance shall be conducted by a combination of the following: - Visual lookout - Radar watch - Other electronic systems available	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Controls based on legislative requirements – must be adopted.	Yes 2.3

[8] Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[8]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
including automatic identification system (AIS) - Monitoring any additional/agreed radio communications channels - All other means available. • Monitor and advise if: - MODU/ intervention vessel / PIV navigation signals are defective - Visibility becomes restricted.				
AHO notified of activity no less than four working weeks prior to undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Notification to AHO will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notices to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Control is Standard Practice.	Yes 3.1
DPIRD notified of activities within three months of undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes 3.2
AMSA notified JRCC of activities 24–48 hours of undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes 3.3
Consultation undertaken with relevant stakeholders for activities within the Petroleum Activities Program that commence more than a year after EP acceptance.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes 3.4

Demonstration of ALARP				
Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[8]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Professional Judgement – Eliminate				
Do not undertake well intervention.	F: Yes, not undertaking well intervention is considered feasible. CS: Potentially significant. Woodside has identified the potential to engage a MODU or intervention vessel of opportunity (i.e. undertaking other activities in the area) to undertake well intervention during the Petroleum Activities Program. Engaging a MODU or intervention vessel of opportunity represents a considerable cost saving to Woodside when compared to contracting a MODU or intervention vessel specifically at a later time.	While it is feasible to eliminate well intervention from the Petroleum Activities Program, to do so would defer intervention to a later date (i.e. defer rather than eliminate the risk).	Disproportionate. The cost/sacrifice grossly outweighs the environmental benefit gained.	No
Sink RTM to seabed to remove hazard to other users.	F: Yes. Sinking the RTM to the seabed would result in reduced hazard at surface. However, it may not be technically feasible to recover once on the seabed. CS: Sinking followed by recovery of the RTM for disposal would impose significant cost upon the Petroleum Activities Program. A vessel capable of securing and lifting the RTM from the seabed would need to be procured to recover the RTM.	While it is feasible to sink the RTM to reduce the surface hazard to other users, it will move the impact to the sea floor, and may not be technically feasible to recover.	Disproportionate. The cost/sacrifice involved with removal of the RTM from the sea floor (if even possible) grossly outweighs the environmental benefit gained.	No
Removal of all subsea infrastructure and flowlines.	F: Yes. However, Woodside has not	While it is feasible to remove all subsea	Disproportionate. The cost/sacrifice	No

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[8]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
	yet finalised the full decommissioning scope for the Enfield development beyond the activities considered in this EP. In order to remove the subsea infrastructure (in particular flowline recovery) a heavy lift vessel will be required to support logistics to remove infrastructure. In addition, any recovery tooling will also need to be modified to suit the specific subsea infrastructure. Full decommissioning scope and feasibility will be assessed at a later stage. CS: Removal of all subsea infrastructure during the Petroleum Activities Program would pose a significant technical, safety and financial risk at this stage of decommissioning. Leaving the infrastructure in situ in a preserved state, does not present a significant environmental risk and eliminates personnel exposure.	infrastructure and flowlines, leaving this infrastructure in situ in a preserved state does not present a significant environmental risk and eliminates personnel exposure.	grossly outweighs the environmental benefit gained.	
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[8]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of the presence of the RTM, project vessels, helicopters and subsea infrastructure on other users, such as commercial fisheries, recreational fishing, nature-based tourism, defence, and shipping. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, the presence of the project vessels, helicopters and subsea infrastructure on other users represents a consequence to commercial fishing, recreational fishing, nature-based tourism, defence, and shipping activities within Operational Area 1 limited to slight. 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 requirements of Australian Marine Orders, and expectations of stakeholders (including AMSA and AHO) determined during consultation. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of presence of the project vessels and subsea infrastructure on other users to a level that is broadly acceptable.

Regarding interference with other aerial operations, the impact assessment has determined that, in its current state, helicopter operations present no lasting effect that is localised and not significant. 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 and risks of helicopter operations to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 1 No unplanned interactions between RTM and marine users.	**C 1.1** Passive radar reflectors and navigation lights maintained on RTM.	**PS 1.1** Passive radar reflectors and navigation lights to be maintained in functional order.	**MC 1.1.1** Records confirm that navigation warning lights are functioning and RTM is clearly detectable by radar.
EPO 2 Prevent adverse interactions between vessels/RTM and other marine users during the Petroleum Activities Program.	**C 2.1a** 500 m safety exclusion zone established around MODU/ intervention vessel and RTM.	**PS 2.1a** No adverse interactions between vessels/RTM.	**MC 2.1.1a** Records of adverse interactions in 500 m petroleum safety zone with other marine users are recorded.
	C 2.2a Activity support vessel(s) on standby during well intervention activities to communicate with third-party vessels and assist in maintaining the safety exclusion zone.	**PS 2.2a** Activity support vessel(s) on continuous standby during well intervention activities to assist in third party vessel interactions (including warning to vessels approaching the 500 m safety exclusion zone) to prevent unplanned interaction and assist in emergencies as required.	**MC 2.2.1a** Records demonstrate activity support vessel(s) present at all times during well intervention activities.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 2.3 Activity support vessel(s) assigned to surveillance will undertake the following actions: • Maintain a 24-hour radio watch on designated radio channel(s) • Undertake continuous surveillance and warn the MODU/ intervention vessel/ PIV (as required) of any approaching vessels reaching 500 m safety exclusion zone. Surveillance shall be conducted by a combination of the following - Visual lookout - Radar watch - Other electronic systems available including automatic identification system (AIS) - Monitoring any additional/agreed radio communications channels - All other means available • Monitor and advise if - MODU / intervention vessel / PIV navigation signals are defective - Visibility becomes restricted.	**PS 2.3** Marine Charterers Instructions implemented which define the role of activity support vessels in maintaining safety exclusion zones, preventing unplanned third party vessel interactions, monitoring the effectiveness of navigation controls (e.g. signals), and warning third party vessels of navigation hazards.	**MC 2.3.1** Records of non-conformance against Marine Charters Instructions maintained.
EPO 3 Marine users aware of the Petroleum Activities Program.	**C 3.1** AHO notified of activity no less than four working weeks prior to undertaking activities within the Petroleum Activity Program.	**PS 3.1** Notification to AHO of activities and movements to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	**MC 3.1.1** Consultation records demonstrate that AHO has been notified before undertaking activities within required timeframes.
	C 3.2 DPIRD notified of activities within three months of undertaking activities within the Petroleum Activity Program.	**PS 3.2** Notification to DPIRD to inform other marine users of the activities to reduce activities interfering with other marine users for longer than necessary.	**MC 3.2.1** Consultation records demonstrate that DPIRD has been notified prior to undertaking activities within required timeframes.
	C 3.3 AMSA notified JRCC of activities 24–48 hours of undertaking activities within the Petroleum Activity Program.	**PS 3.3** Notification to AMSA JRCC to prevent activities interfering with other marine users. AMSA's JRCC will require the MODU's details (including	**MC 3.3.1** Consultation records demonstrate that AMSA JRCC has been notified prior to undertaking

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and need to be advised when operations start and end.	activities within required timeframes.
	C 3.4 Consultation undertaken with relevant stakeholders for activities within the Petroleum Activities Program that commence more than a year after EP acceptance.	**PS 3.4** In order to prevent activities interfering with other marine users, relevant stakeholders consulted no less than four working weeks prior to scheduled activity commencement date.	**MC 3.4.1** Consultation records demonstrate relevant stakeholders have been consulted with prior to undertaking activities within required timeframes.

6.6.1.2 Physical Presence: Disturbance to Seabed from Infrastructure Laydown and Subsea Equipment including MODU Anchors within Operational Area 1

Context	
RTM removal – **Section 3.6** Mooring installation and anchor hold testing – **Section 3.11.2**	Physical environment – **Section 4.3** Biological environment – **Section 4.4**

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/ Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Disturbance to benthic habitat from laydown of infrastructure (RTM mooring lines) within Operational Area 1		X	X		X			A	F	LCS GP PJ	Broadly acceptable	EPO 5
Disturbance to the seabed from the deployment of subsea equipment (MODU anchors and ROV activities) within Operational Area 1		X	X		X			A	F			

Description of Source of Impact

Laydown of infrastructure

During the Petroleum Activities Program the mooring lines attached to the RTM will be laid upon the seabed within Operational Area 1, until final decommissioning. Laydown of mooring lines on the seabed will result in localised and temporary disturbance to the seabed. The mooring lines will be placed alongside existing infrastructure to limit the amount of disturbance to the seabed. Laydown of mooring lines is expected to result in seabed disturbance, with a total disturbance footprint of approximately 4.23 ha. A radius of 1.5 km from existing infrastructure has been selected to provide the project vessels the ability to laydown the mooring lines within a previously disturbed area, thereby limiting further seabed disturbance.

Deployment of subsea equipment

Equipment deployed to the seabed during the Petroleum Activities Program includes:

- mooring installation for MODU anchors
- ROVs.

Seabed disturbance will result from anchor hold testing for the MODU mooring system, including placement of anchors on the seabed, potential dragging during tensioning and recovery of anchors.

The use of the ROVs during Petroleum Activities Program may result in temporary seabed disturbance and suspension of sediment as a result of working close to, or occasionally on, the seabed. ROV use close to or on the seabed is limited to that required for effective and safe subsea activities. The footprint of a typical work class ROV is approximately 2.5 m by 7 m.

Impact Assessment
Potential impacts to environmental values
Ecosystems / Habitats The laydown of mooring lines on the seabed will affect a relatively small footprint on the seabed within Operational Area 1 below the RTM, along with the additional subsea infrastructure that was laid on the seafloor during cessation operations. The deployment, use and retrieval of the mooring system for a MODU and anchor hold testing is likely to result in a localised short-term physical modification to a small area of the seabed and disturbance to soft sediment. Benthic habitats within the footprint of the infrastructure laydown consist of soft, unconsolidated sediments which host sparse assemblages of filter- and deposit-feeding epifauna and infauna, as well as demersal fishes. These soft sediment habitats, and associated biological communities, are widely represented throughout the NWMR and are not considered to be of particular conservation significance. The laydown of infrastructure will not overlap canyon habitat and will be restricted to the area surrounded by the existing FPSO mooring anchors. The potential discharge of minor quantities of produced sand and scale at or near the seabed may lead to localised smothering and increased sedimentation, as well as localised contamination of the seabed surface sediments. Produced sands and scale within the riser may contain minor quantities of naturally occurring radioactive material (NORM). However, given the routine use of scale inhibitor and flushing of subsea infrastructure, the potential for scale to develop within the risers is considered to be very low. ***Marine Sediments*** The mooring lines were designed for long-term use in the marine environment and are constructed to resist corrosion / decomposition. Additionally, subsea infrastructure was flushed and filled with preservation fluid and capped to further inhibit corrosion and degradation through biological activity. As such, no significant decomposition is expected to occur during the period of this EP. Note that the fate of subsea infrastructure has not been finalised and will be the subject to a future environmental approval. ***Water quality*** The laydown of infrastructure, deployment of anchors and use of ROVs near the seabed is expected to lead to localised, temporary resuspension of sediments. Sediments in Operational Area 1 are characterised by silts and muds, however, is expected to be limited to within Operational Area 1. Given the discrete, one-off nature of laydown and MODU anchoring activities, sediment resuspension events will be of short duration and involve relatively small quantities of sediment. Impacts are expected to consist of a short duration increase in total suspended sediment load in the vicinity of Operational Area 1. Sedimentation is a naturally occurring process, and benthic organisms are adapted to survive sedimentation. As such, no significant impacts to benthic fauna are expected. ***Canyons KEF*** The ecological values of the Canyons KEF (and the Enfield Canyon in particular) are discussed in **Section 4.6.7.** These include the potential of enhanced productivity due to upwelling and increased connectivity between the continental shelf and the deep ocean. Woodside's environmental survey of the Enfield Canyon indicated that the canyon habitat hosts more diverse and abundant fish assemblages relative to surrounding non-canyon habitat. While Operational Area 1 overlaps a small portion of the Canyons KEF, the ecological functions of the Canyons KEF (enhanced upwelling, conduit between continental shelf and deep sea, diverse biological assemblages) are not predicted to be impacted by the Petroleum Activities Program.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, seabed disturbance will be limited to localised impacts to benthic habitat, water quality and marine sediment within Operational Area 1, with no lasting effect.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[9]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Project-specific Mooring Design Analysis.	F: Yes CS: Standard activity, no significant additional	The mooring design analysis determines the number and spread of anchors	Benefits outweigh cost/sacrifice	Yes C 5.1

[9] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	cost associated with activity.	required based on sediment type and seabed topography, reducing the likelihood of anchor drag leading to seabed disturbance.		
Woodside Well Location and Site Appraisal Data Sheet (WLSADS) includes environmental sensitivities and seabed topography to inform the selection of the MODU mooring locations.	F: Yes CS: Minimal cost. Standard practice	Reduces the likelihood of anchoring occurring in areas of high sensitivity. Assessment of seabed topography reduces the likelihood of anchor drag leading to seabed disturbance.	Benefits outweigh cost/sacrifice	Yes C 5.2
Laydown of RTM mooring lines in pre-defined area to limit the extent of disturbance to the seabed.	F: Yes CS: Standard activity, no significant additional cost associated with activity.	Reduces the likelihood of laydown of mooring lines in areas of high sensitivity.	Benefits outweigh cost/sacrifice	Yes C 5.3a
Environmental monitoring of the seabed before and after the Petroleum Activities Program to assess any impacts to seabed.	F: Yes. CS: Significant. Monitoring of the seabed, particularly the deep waters of the Operational Area, would have significant additional costs to obtain and analyse data with the spatial resolution to accurately assess changes to the seabed habitat.	Environmental monitoring would not result in any additional information of the seabed above that already collected. Therefore, no additional reductions in likelihood or consequence would occur.	Control grossly disproportionate. Monitoring will not reduce the consequence or likelihood of any impacts to the seabed, and the cost associated with the level of monitoring required to accurately assess any impacts greatly outweighs the benefits gained. Although adopting this control could be used to verify EPOs, alternative controls identified also allow demonstration that the environmental outcome has been met based on the nature of the activity (i.e. predictable impacts) and relatively low sensitivity of the area.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Do not use ROV close to, or on, the seabed.	F: No. The use of ROVs (including work close to or occasionally landed on the seabed) is critical as the ROV is the main tool used to guide and manipulate equipment during activities. ROV usage is already limited to only that required to conduct the work effectively and safely. Due to visibility and operational issues ROV work on or close to the seabed is avoided unless necessary. CS: Not considered – control not feasible	Not considered – control not feasible	Not considered – control not feasible	No
Professional Judgement – Substitute				
Only use DP MODU (no anchoring required)	F: Yes, however a DP MODU cannot be guaranteed for intervention activities. CS: Restricting MODU selection to only DP capable rigs could introduce unacceptable additional costs and operational delays. Woodside has a demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	Slight reduction in the footprint on the sea floor. However, given the predicted limited footprint which will occur within an area of existing disturbance, the environmental benefit is negligible.	Disproportionate. The cost/sacrifice outweighs the environmental benefit gained.	No
Professional Judgement – Engineered Solution				
Recovery of mooring lines at the time of RTM disconnection (i.e. no laydown on seabed).	F: Yes. It is possible to recover the mooring lines at the time of disconnection. However, the fate of these components has not yet been determined and is the subject of future investigation by Woodside. Recovery of mooring lines would require additional vessels in the field (HLV and additional AHT).	Slight reduction in the footprint on the sea floor. However, given the predicted limited footprint which will occur within an area of existing disturbance, the environmental benefit is negligible.	Disproportionate. The cost/sacrifice outweighs the environmental benefit gained.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Significant. Recovery of the mooring lines at the time of disconnection from the RTM would require significant additional vessel resources capable of recovering the mooring lines. Given the fate of the mooring lines is yet to be determined, the operational sequence of the Petroleum Activities Program does not allow for the recovery of mooring lines at the time of disconnection from the RTM.			
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 disturbance to the seabed from infrastructure laydown and equipment deployment. As no reasonable additional/alternative controls were identified that would further reduce the impacts without disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement
The impact assessment has determined that, given the adopted controls, disturbance to the seabed from infrastructure laydown and subsea equipment represents a consequence to benthic community/habitat structure limited to no lasting effect. 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 Woodside's relevant systems and procedures. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 5 No impacts to benthic habitats greater than a consequence level of F[10].	**C 5.1** Project-specific Mooring Design Analysis.	**PS 5.1** Seabed disturbance from MODU mooring limited to that required to ensure adequate MODU station holding capacity.	**MC 5.1.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
	C 5.2 Woodside WLSADS includes environmental sensitivity and seabed topography to inform the selection of the MODU mooring locations.	**PS 5.2** Well site locations as planned within WLSADS.	**MC 5.2.1** Data verifies well location as planned within WLSADS.

[10] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.'

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 5.3a Laydown of RTM mooring lines in pre-defined area to limit the extent of disturbance to the seabed.	**PS 5.3a** All infrastructure laydown limited to within 1.5 km radius of existing subsea infrastructure[11] to limit the extent of disturbance to the seabed	**MC 5.3a.1** An 'as left survey' will be undertaken to verify that infrastructure laydown and subsea equipment deployment is within pre-defined corridors

[11] The Operational Area is defined as the combined delineated distances from the following: 1500 m area from the RTM, 4000 m area around all wells and 500 m area around flowlines

6.6.1.3 Routine Discharges: Project Vessel Operations within Operational Area 1

Context

Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/ Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine discharge of sewage, grey water and putrescible wastes to marine environment from project vessels operating within Operational Area 1			X					A	F	LCS GP PJ	Broadly acceptable	EPO 6
Routine discharge of deck and bilge water to marine environment from project vessels operating within Operational Area 1			X					A	F			
Routine discharge of cooling water or brine to the marine environment from project vessels operating within Operational Area 1			X					A	F			

Description of Source of Impact

Time frames for conducting activities within Operational Area 1 are outlined in **Section 3.4**. The project vessels involved with these activities are expected to routinely generate/discharge the following:

- Small volumes (typically 15 m^3 per project vessel per day) of treated sewage, grey water and putrescible wastes to the marine environment.
- Routine/periodic discharge of relatively small volumes of bilge water. Bilge tanks on project vessels receive fluids from many parts of the vessel. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals.
- Variable water discharge from project vessel decks directly overboard or via deck drainage systems. Water sources could include rainfall events and/or from deck activities such as cleaning/wash-down of equipment/decks.
- Cooling water from machinery engines and brine water produced during the desalination process of reverse osmosis to produce potable water on board project vessels.

Environmental risk relating to the disposal/discharges above regulated levels or incorrect disposal/discharge of waste would be unplanned (non-routine/accidental) and are addressed in **Section 6.6.2.6**.

Impact Assessment

Potential impacts to environmental values

The main environmental impact associated with ocean disposal of sewage and other organic wastes (i.e. putrescible waste) is eutrophication. Eutrophication occurs when the addition of nutrients, such as nitrates and phosphates, causes adverse changes to the ecosystem, such as oxygen depletion and phytoplankton blooms. Other contaminants of concern occurring in these discharges may include ammonia, *E. coli*, faecal coliform, volatile and semi-volatile organic compounds, phenol, hydrogen sulphide, metals, surfactants and phthalates.

Woodside monitored sewage discharges at its Torosa-4 Appraisal Drilling campaign which demonstrated that a 10 m^3 sewage discharge reduced to about 1% of its original concentration within 50 m of the discharge location. In addition

to this, monitoring at distances of 50, 100 and 200 m downstream of the platform and at five different water depths confirmed that discharges were rapidly diluted and no elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside Energy Limited, 2011). Mixing and dispersion would be further facilitated in deep offshore waters, consistent with the location of Operational Area 1, through regional wind and large scale current patterns resulting in the rapid mixing of surface and near surface waters where sewage discharges may occur. Studies investigating the effects of nutrient enrichment from offshore sewage discharges indicate that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed areas (McIntyre and Johnston, 1975). Furthermore, open marine waters do not typically support areas of increased ecological sensitivity, due to the lack of nutrients in the upper water column and lack of light penetration at depth. Therefore, presence of receptors, such as fish, reptiles, birds and cetaceans, in significant numbers within Operational Area 1 is unlikely. Research also suggests that zooplankton composition and distribution are not affected in areas associated with sewage dumping grounds (McIntyre and Johnston, 1975). Plankton communities are expected to rapidly recover from any such short-term, localised impact, as they are known to have naturally high levels of mortality and a rapid replacement rate. Additional discharges outlined, which may include other non-organic contaminants (e.g. bilge water), will be rapidly diluted through the same mechanisms as above and are expected to be in very small quantities and concentrations as to not pose any significant risk to any relevant receptors. As such, no significant impacts from the planned (routine and non-routine) discharges that are listed above are anticipated because of the minor quantities involved, the expected localised mixing zone and high level of dilution into the open water marine environment of Operational Area 1. Operational Area 1 is more than 12 nm from land, which exceeds the 12 nm exclusion zones required under the relevant Marine Orders. While the Petroleum Activities Program may extend for several years, vessels will not be continuously in Operational Area 1 during this time, and will also be moving (i.e. not in a single location for an extended period of time). As a result, these routine and non-routine discharges are expected to be intermittent in nature for the duration of the Petroleum Activities Program. Therefore, cumulative impacts to water quality within Operational Area 1 are expected to be localised and short-term with no lasting effect. It is possible that protected marine fauna transiting the localised area may come into contact with these discharges (e.g. as they traverse Operational Area 1 during their seasonal migrations (**Section 4**). However, given the localised extent of cumulative impacts from multiple vessel discharges within the Operational Area, impacts to marine fauna are not expected.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that routine or non-routine discharges described will not result in a potential impact greater than localised contamination not significant to environmental receptors, with no lasting effect.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[12]	***Benefit in Impact/Risk Reduction***[13]	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps to pass through a macerator so it is capable of passing through a screen with no opening wider than 25 mm.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 6.1

[12] Qualitative measure

[13] Measured in terms of reduction of likelihood (L), consequence (C) and current risk rating (CRR)

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact/Risk Reduction[13]***	***Proportionality***	***Control Adopted***
Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention Certificate, as required by vessel class • an AMSA-approved sewage treatment plant • a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 nm from the nearest land • discharge of sewage which is comminuted or disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 nm from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (> 4 knots), to avoid discharges in environmentally sensitive areas.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 6.2
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage will be collected via a closed drainage system. E.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes C 6.3

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact/Risk Reduction[13]***	***Proportionality***	***Control Adopted***
Marine Order 91 – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water prior to discharge: • Machinery space bilge/oily water shall have IMO-approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure Oil in Water (OIW) content to be less than 15 ppm prior to discharge. • IMO-approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating if OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • If machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed onshore. • Valid International Oil Pollution Prevention Certificate.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 6.4
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
Storage, transport and treatment / disposal onshore	F: Not feasible. Would present additional safety and hygiene	Not considered – control not feasible.	Not considered – control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact/Risk Reduction[13]***	***Proportionality***	***Control Adopted***
of sewage, greywater, putrescible and bilge wastes.	hazards resulting from the storage, loading and transport of the waste material CS: Not considered – control not feasible			
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impact of planned (routine and non-routine) discharges from project vessels. 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, planned discharges (routine and non-routine) from project vessels is unlikely to result in a potential impact greater than temporary contamination above background levels and/or national/international quality standards and/or known biological effect concentrations outside a localised mixing zone with no lasting effect. 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 95 and 96. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 6 No impact to water quality greater than a consequence level of F[14] from discharge of sewage, greywater, putrescible wastes, bilge and deck drainage to the marine environment during the Petroleum Activities Program.	**C 6.1** Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps to pass through a macerator so it is capable of passing through a screen with no opening wider than 25 mm.	**PS 6.1** Project vessels compliant with Marine Order 95 – pollution prevention – Garbage.	**MC 6.1.1** Records demonstrate activity support vessels and MODU are compliant with Marine Order 95 – pollution prevention (as appropriate to vessel class).
	C 6.2 Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention Certificate, as required by vessel class • an AMSA-approved sewage treatment plant	**PS 6.2** Project vessels compliant with Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class).	**MC 6.2.1** Records demonstrate project vessels are compliant with Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class).

[14] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.'

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 nm from the nearest land • discharge of sewage which is comminuted or disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 nm from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (>4 knots), to avoid discharges in environmentally sensitive areas.		
	C 6.3 Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage will be collected via a closed drainage system. E.g. drill floor.	**PS 6.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 6.3.1** Records demonstrate MODU has a bilge/oily water management systems that is compliant Engineering Standard for Rig Equipment.
	C 6.4 Marine Order 91 – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water prior to discharge: • Machinery space bilge/oily water shall have IMO-approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure OIW content to be less than 15 ppm prior to discharge. • IMO-approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating if OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high	**PS 6.4.1** Discharge of machinery space bilge/oily water will meet oil content standard of <15 ppm without dilution. **PS 6.4.2** Deck drainage and bilge water will be discharged to meet the oil content standard of <15 ppm without dilution.	**MC 6.4.1** Records demonstrate discharge specification met for MODU and project vessels. **MC 6.4.2** Records demonstrate maintained and up-to-date oil discharge records for the project vessels.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • If machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed onshore. • Valid International Oil Pollution Prevention Certificate.		

6.6.1.4 Routine and Non-routine Discharges: Hydrocarbons, Chemicals and Well Intervention Fluids within Operational Area 1

Context	
RTM Removal – **Section 3.7.2** Subsea IMMR Chemicals – **Section 3.8.4** Well Intervention – **Section 3.9** Assessment of Project Chemicals – **Section 3.13**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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*	*ALARP Tools*	*Acceptability*	*Outcome*
Non-routine discharges to the marine environment during RTM removal activities.			X			X		A	E	LCS GP PJ	Broadly acceptable	EPO 7
Routine and non-routine discharges to the marine environment during IMMR activities.			X			X		A	F			
Routine discharge of cement and wellbore fluids to the seabed and the marine environment during well intervention activities.		X			X			A	F			

Description of Source of Risk

During the Petroleum Activities Program, small volumes of hydrocarbons, chemicals and well intervention fluids may be discharged intermittently and for short durations as a result of planned breaking of containment of the preserved subsea system, preparing the RTM for removal, and non-routine operations and inspection and maintenance activities. This includes discharges of treated seawater during the disconnection of subsea infrastructure, release of control fluid from valves (including the BOP) and minor discharge of the contents of umbilicals.

Expected worst-case releases are detailed below:

- Small quantities (10–20 L) of hydraulic fluid, biocide, corrosion inhibitor, oxygen scavenger and residual hydrocarbons present in treated seawater when breaking containment of subsea system (e.g. well intervention activities). Note that the subsea infrastructure has been flushed until the residual hydrocarbon concentration was considered to be ALARP (undertaken under NGA Facility Operations EP).
- Small quantities of BOP control fluid may be released during testing of the BOP during well intervention activities;
- Small quantities of corrosion inhibitor and residual hydrocarbons contaminating the kill weight brine may be discharged from the MODU.
- Small quantities of cement discharged to the marine environment during well intervention, with potential discharge of small quantities of excess cement following completion of well intervention.
- Small quantities (up to 25 L of demulsifier, 40 L scale inhibitor, and 60 L of methanol) of operations fluids may be released subsurface to the ocean from the EHU tail and piping on the RTM.
- Up to 180 L of a mix of demulsifier, scale inhibitor, methanol and rainwater may be decanted from the drain pot on the RTM, with the residue flushed to the ocean. The worst credible scenario is the drain pot is full (maximum capacity) and the 180 L is unable to be decanted and must be flushed to the ocean.

Kill weight brine (including corrosion inhibitors) will be used to maintain control of wells during intervention activities. Residual hydrocarbons within wells may contaminate the brine. Brine may be re-injected, recovered and disposed of onshore, or treated and discharged at sea. Brine will be treated prior to discharge to ≤1% hydrocarbon by volume.

Cementing fluids are not routinely discharged to the marine environment; however, volumes of up to approximately 2 m^3 per well when surplus fluids require disposal after cementing operations. Cement spacers can be used as part of the cementing process within the well casing to assist with cleaning of the casing sections prior to cement flow through. The spacers may consist of either seawater or a mixture of seawater and dye. The dye is used to provide a pre-indicator of cement overflow to the seabed surface, to ensure adequate cement height.

Excess cement (dry bulk, after well operations are completed) or cement which does not meet technical requirements will either be used for subsequent wells, provided to the next operator at the end of the well intervention program or if these options are not practicable, discharged to the marine environment as a slurry.

Marine growth removal from subsea infrastructure may also be required. Marine growth removal may involve the following activities:

- water jetting using high pressure water to remove marine growth
- use of brushes attached to ROV
- use of acid (typically sulfamic acid) to dissolve calcium deposits
- use of sand/abrasive blasting using staurolite products (naturally occurring mineral).

Small discharges of chemicals (e.g. sulfamic acid) or sand are likely from marine growth removal activities.

When preparing for RTM removal, the fluids retained in the drain pot are planned to be decanted, with only the residue flushed to the ocean. However, if this is not reasonably practicable, then an ALARP assessment will be completed to determine how the discharge can be done a way that reduces the risks and impacts to the environment to ALARP and are acceptable. The ALARP assessment shall consider the following mitigation measures:

1. released over an extended duration
2. released subsurface.

All chemicals that may be released or discharged to the marine environment during the Petroleum Activities Program are assessed as per Woodside Chemical Selection and Assessment Guideline. This guideline is used to demonstrate that the potential impacts of the chemicals that may be released are acceptable and ALARP (refer to **Section 3.13**).

Impact Assessment

Potential impacts to environmental values

The release of minor hydrocarbon and chemical discharges may reduce local water quality through contamination of the water column, resulting in potential adverse effects to marine biota as a result of hydrocarbon and chemical toxicity. The discharges present a risk to the marine environment due to the contaminants within them.

Potential impacts to sensitive receptors may be attributable to dissolved hydrocarbons and suspended oil droplets and nutrients, as well as low residual concentrations of a small number of chemicals such as corrosion and scale inhibitors and biocides. Hydrocarbons, however, are considered the constituent of most concern to marine fauna, particularly polycyclic aromatic hydrocarbons (PAHs).

Minor Hydrocarbon Discharges

Hydrocarbon exposure can lead to mortality of marine organisms within the immediate vicinity of a discharge plume, as well as sub-lethal chronic (long exposure) effects such as decreased genetic diversity in communities, decreased growth and fecundity, lower reproductive success, respiratory problems, behavioural and physiological problems, decreased developmental success and endocrine disruption (Neff et al., 2011).

Further details on potential biological and ecological impacts associated with hydrocarbon spills are presented in **Section 6.6.2.2**. A minor loss of hydrocarbon will be much reduced in terms of spatial and temporal scales, and given the minor quantities expected to be released, impacts to limited transient megafauna, plankton and fish populations (water column biota) are considered to be highly unlikely. No impacts to commercial fisheries, sensitive environmental receptors or KEFs are expected as impacts will be limited to temporary and localised contamination of water and highly localised impacts to lower-order species within the immediate vicinity of the discharge location. No impacts to any protected species will occur.

Cement

Cement discharges are not expected to widely disperse and are expected to settle on the seabed in the immediate vicinity of the well head. The impact of cement discharge at the seabed will therefore, be limited to affecting sediment quality and any surrounding benthic and/or infauna communities, in a small localised area immediately around the wells. The seabed which may be impacted around the wellheads is expected to have residual cuttings, and has been previously disturbed.

The seabed in Operational Area 1 comprises soft, unconsolidated sediments hosting sparse infauna and epifauna assemblages. This habitat is widely represented in the region. As such, the seabed subject to potential cement discharges is considered to be of low sensitivity and impacts will be localised with no lasting effect. No impacts to the ecosystem functions of the Canyons KEF are expected.

Chemical Discharges
The release of treated seawater containing preservation chemicals, marine growth removal chemicals and the minor discharge of control fluid from subsea valves (e.g. BOP) and umbilicals may decrease the water quality in the immediate area of the release; however, the impacts are expected to be of no lasting effect due to rapid dilution in the open ocean environment. If the drain pot cannot be decanted, and needs to be flushed to the ocean, this will be completed in way that is acceptable and ALARP. To achieve this may require the discharge to be over an extended duration to maximise the dilution and minimise potential impacts, and/or discharged below the sea surface to aid dilution. The fluids were selected using Woodside's chemical assessment process and at the time were rated Gold (scale inhibitor) and E (PLONOR) (methanol). The demulsifier was OCNS ranked D with a substitute warning. As such, careful consideration and understanding of the discharge will be required to minimise impacts. Given the above, if discharged, decreased water quality will occur in the immediate area of the release; the impacts are expected to be of slight, short-term impact (<1 year) on species due to rapid dilution in the open ocean environment and expected mitigation controls to minimise impacts of the release. Marine fauna may be affected if they come in direct contact with a release (i.e. by traversing the immediate discharge area). There are no EPBC Act listed critical habitats within the Operational Area. Given the small volumes that represent the worst credible releases, and the dilution of any such discharge, the likelihood of ecological impacts to these marine fauna is considered to be highly unlikely. The release of treated seawater containing small quantities of biocide and corrosion inhibitor in the treated seawater during breaking of containment of the subsea system may result in a localised, temporary minor decrease in water quality. The chemicals were added to the subsea system as components of the preservation fluid (note the system is depressurised). Given the dosage concentration of biocide sticks and oxygen scavenger and the subsea system has been depressurised to ambient hydrostatic pressure, potential impacts from any such releases are expected to be of no lasting effect. All chemicals added to the treated seawater are subject to the chemical assessment process described in **Section 3.13**. No impacts to commercial or recreational fisheries, KEFs or protected species are expected.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that routine and non-routine discharges of hydrocarbons, chemicals and well intervention fluids described will be limited to slight, short-term impact (<1 year) on water quality, benthic habitats and species within Operational Area 1 due to the temporary contamination of water above background levels.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[15]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Well Intervention fluids and additives will have an environmental assessment completed prior to use.	F: Yes CS: Minimal cost. Standard practice.	Environmental assessment of chemicals will reduce the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice	Yes C 7.1

[15] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Displacement, brine, workover or intervention fluids contaminated with hydrocarbons will be treated prior to discharge or contained. If discharge specification is not met, the fluid will be returned to shore.	F: Yes CS: Minimal cost. Standard practice.	Ensuring <1% oil content will provide a small reduction in consequence when fluids are discharged to the environment.	Benefits outweigh cost/sacrifice	Yes C 7.2
Bulk operational discharges conducted under Permit to Work (PTW) system (to operate discharge valves/pumps).	F: Yes CS: Minimal cost. Standard practice.	The PTW system may slightly reduce the likelihood of bulk discharges occurring, but it is unlikely to be significant given bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes C 7.3
Return residual cement onshore for treatment/disposal	F: Yes. However, cement slurry may harden during transport, introducing difficulty in handling and transportation. CS: Given the non-toxic nature of cement and the relatively small volumes of cement generated, the cost sacrifice involved in transporting cement to shore-based disposal is significant.	Not discharging cement to the marine environment would eliminate the likelihood and consequence of impacts from such activities.	Disproportionate. Given the non-toxic nature of cement, the cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Eliminate				
Do not use preservation chemicals	F: No. Preservation fluids are required to maintain the structural integrity of the subsea infrastructure during the preservation period. The volume is determined by technical requirements. CS: Not considered – control not feasible	Not considered – control not feasible	Not considered – control not feasible	No
Do not flush drain pot to ocean	F: Yes. CS: Risk to personnel to undertake activity to decant.	Safety reduction if drain pot cannot be decanted.	May be disproportionate. Given the risk of the discharge to the environment is low due to the controls that will be adopted to minimise the impact of the substances and the	Yes, where practicable C 7.4

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
			low sensitivity of the receiving environment, it is considered a negligible environmental risk. The cost/sacrifice may outweigh the benefit gained.	
Professional Judgement – Substitute				
Use of excess bulk cement on subsequent wells or pass onto subsequent operator	F: Yes. However the cement may not meet the required technical specifications, and hence not be usable. Can degrade if not reused within short time therefore, no longer meeting the technical performance requirements. CS: Inability to conduct the activities if degraded	Using excess bulk cement on subsequent wells would eliminate the bulk discharge of cement to the marine environment and would eliminate the likelihood and consequence of impacts from such activities.	Disproportionate. Given the risk of the cement discharge and other down-well products to the environment is low due to the benign nature of the substance and the low sensitivity of the receiving environment, it is considered a negligible environmental risk. The cost/sacrifice may outweighs the benefit gained.	Yes, where practicable C 7.5
Professional Judgement – Engineered Solution				
Intervention fluids or suspension brine which may have come into contact with non water-based muds (NWBM) or reservoir hydrocarbons should be processed through a water treatment package prior to discharge.	F: Yes CS: Minimal cost	Treatment of returned may slightly reduce the consequence of impacts resulting from discharges to the marine environment	Benefits outweigh cost/sacrifice.	Yes C 7.6
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of routine and non-routine discharges of minor quantities of hydrocarbons, chemicals and well intervention fluids. 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, routine and non-routine discharges of minor quantities of hydrocarbons, chemicals and well intervention fluids represent no lasting effect with only temporary contamination above background levels and/or national/international quality standards and/or known biological effect concentrations. Further opportunities to reduce the impacts and risks have been investigated above. The adopted

controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 7 No impact to water quality or marine biota greater than a consequence level of E[16] from discharging fluids during the Petroleum Activities Program.	**C 7.1** Well Intervention fluids and additives will have an environmental assessment completed prior to use.	**PS 7.1** Well intervention fluids and fluids intended or likely to be discharged to the marine environment, will have an environmental assessment completed before use and will be discharged in accordance with the mitigation measures identified in the ALARP to ensure the discharge is ALARP and acceptable.	**MC 7.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 7.2 Displacement, brine, workover or intervention fluids contaminated with hydrocarbons will be treated prior to discharge or contained. If discharge specification is not met, the fluid will be returned to shore.	**PS 7.2** Achieves oil concentration <1% by volume prior to discharge.	**MC 7.2.1** Records demonstrate that discharge criteria was met prior to discharge or contained.
	C 7.3 Bulk operational discharges conducted under PTW system (to operate discharge valves/pumps).	**PS 7.3** Bulk operational discharges are conducted under a PTW system to operate discharge valves/pumps.	**MC 7.3.1** Records demonstrate that bulk discharges are conducted under the MODU PTW system.
	C 7.4 For preparation of RTM removal, the fluids retained in the drain pot are planned to be decanted, with only the residue flushed to the ocean. If this is not reasonably practicable to achieve, then an ALARP assessment will be completed to determine how the discharge can be undertaken in a way that the risks and impacts to the environment are reduced to ALARP and are acceptable.	**PS 7.4** The ALARP shall consider the following mitigation measures: • released over an extended duration • released subsurface	**MC 7.4.1** Chemical discharge ALARP assessment demonstrates why the decanting of the drain pot is not reasonably practicable, and that mitigation measures have been considered and applied to reduce the impacts and risks of discharge to be ALARP and acceptable.
	C 7.5 Excess bulk cement will be used on subsequent wells or passed onto subsequent operator, where feasible – cost effective and technically viable	**PS 7.5** An assessment will be undertaken to determine feasibility of cement use on subsequent wells or by subsequent operator	**MC 7.5.1** Decision note documenting assessment of cost effectiveness and technically feasibility of cement re-use.
	C 7.6 Intervention fluids or suspension brine which may have come into	**PS 7.6** All intervention fluids or suspension brine which may	**MC 7.6.1** Environmental discharge report records

[16] Defined as 'Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	contact with NWBM or reservoir hydrocarbons should be processed through a water treatment package prior to discharge.	have come into contact with reservoir hydrocarbons will be discharged with a hydrocarbon content of 1% or less.	demonstrate water treatment package has been used to process intervention/workover fluids where NWBM or reservoir hydrocarbon contamination may be present

6.6.1.5 Routine Light Emissions from Activities within Operational Area 1

Context	
Project vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine light emissions from project vessels and MODU within Operational Area 1						X		A	F	LCS GP PJ	Broadly acceptable	N/A

Description of Source of Risk

Routine light emissions include light sources that alter the ambient light conditions in an environment. Project vessels and the MODU will routinely use external lighting to navigate and conduct safe operations at night throughout the Petroleum Activities Program. External light emissions from project vessels and the MODU are typically managed to maintain good night vision for crew members. Vessel/MODU lighting will also be used to communicate the vessel's presence to other marine users (i.e. navigation/warning lights). Lighting is required for safely operating project vessels/MODU and cannot reasonably be eliminated.

The vessels that may be required for the Petroleum Activities Program in Operational Area 1 are outlined in **Section 3.10**. External lighting is located on the vessel/MODU decks, with most external lighting directed towards working areas such as the main decks. These areas are typically <20 m above sea level. Indicative timing for activities within Operational Area 1 are provided in **Table 3-3**, **Table 3-21** and **Table 3-22**. Note: Flaring, which is a relatively bright light source, will not occur during the activity.

Lighting from vessels/MODU may appear as a direct light source from an unshielded lamp with direct line of sight to the observer or through sky glow. Direct lighting falling upon a surface is referred to as light spill. Sky glow 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 sky glow may be visible from the source depends on the vessel/MODU lighting and environmental conditions.

Receptors that have important habitat within a 20 km buffer of the Operational Area were considered for the impact assessment, based on recommendations of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (NLPG). The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15–18 km and fledgling seabirds grounded in response to artificial light 15 km away (NLPG, 2020).

Impact Assessment

Potential impacts to environmental values

Receptors that have important habitat within a 20 km buffer of the Operational Area were considered for the impact assessment, based on recommendations of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (NLPG). The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15–18 km and fledgling seabirds grounded in response to artificial light 15 km away (NLPG, 2020).

Light emissions can affect fauna in two main ways:

- *Behaviour*: Organisms are adapted to natural levels of lighting and the natural changes associated with the day and night cycle as well as the night-time phases of the moon. However, artificial lighting has the potential to create a constant level of light at night that can override these natural levels and cycles.
- *Orientation*: Some organisms (e.g. marine turtles, birds) may also use lighting from natural sources to orient themselves in a certain direction at night. If an artificial light source is brighter than a natural source, the artificial light may override natural cues, leading to disorientation.

The fauna within and immediately adjacent to Operational Area 1 are predominantly pelagic fish and zooplankton, with a low abundance of transient species such as marine turtles, whale sharks, cetaceans and migratory shorebirds and seabirds. There is no known critical habitat within Operational Area 1 for EPBC Act listed species. However, Operational Area 1 overlaps a BIA (breeding and foraging) for the wedge-tailed shearwater.

Marine Turtles – Hatchlings

As discussed in **Section 4.4.3.3**, turtle hatchlings emerge from the nest and orient towards the sea. After entering the water, hatchlings use a combination of cues (wave direction and currents) to orient and travel into offshore waters. Impacts to the sea-finding behaviour of hatchlings are more common for light sources behind a beach, as lighting offshore will orient emerging hatchlings towards the sea. Artificial light at close distances can also impact hatchling dispersal once they are in the water. Light spill may ‘entrap’ hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predators via silhouetting (Salmon et al., 1992).

The nearest nesting site in relation to Operational Area 1 is along the western extent of North West Cape (about 33 km distant); therefore, sky glow and light spill from project vessels/MODU will not reach any nesting beach. Any impacts to hatchling turtles from artificial light will be limited to possible short-term behavioural impacts to isolated individual hatchlings offshore, with no lasting effect to the species.

Marine Turtles – Adults

Although individuals undertaking behaviours such as internesting, migration, mating (adults) or foraging (adults and pelagic juveniles) may occur within Operational Area 1, marine turtles do not use light cues to guide these behaviours. Furthermore, there is no evidence, published or anecdotal, to suggest that internesting, mating, foraging or migrating turtles are impacted by light from offshore vessels. As such, light emissions from the vessels are unlikely to result in displacement of, or behavioural changes to individuals in these life stages (Pendoley Environmental [PENV], 2020b).

Artificial lighting may affect where nesting adult turtles emerge onto the beach, the success of nest construction, whether nesting is abandoned, and the seaward return of adults (Salmon et al., 1995a, 1995b; Salmon and Witherington, 1995). Such lighting is typically from residential and industrial development at the coastline, rather than offshore from nesting beaches. The North West Cape (around 33 km from Operational Area 1) is a known nesting location, however, light from the project vessels/MODU will not be visible as sky glow or light spill to nesting adult turtles. As such, vessel/MODU light sources will not discourage females from nesting, or affect nest site selection, and therefore will not displace females from nesting habitat.

Operational Area 1 does not contain any known critical habitat for any species of marine turtle, and no BIAs for turtles overlap Operational Area 1. It is acknowledged that marine turtles may be present transiting Operational Area 1 in low densities; however, given the water depth (~400–600 m), turtles are unlikely to be foraging within the area and their presence will be limited to individuals temporarily transiting the area. As such, light emissions from project vessels/MODU are unlikely to result in more than localised behavioural disturbance to isolated transient individuals, with no lasting effect to the species.

Seabirds and Migratory Shorebirds

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). Operational Area 1 may be occasionally visited by seabirds and migratory shorebirds; however. there is no emergent land that could be used for roosting or nesting habitat in Operational Area 1. The nearest shoreline is North West Cape (33 km from the Operational Area 1).

Migratory shorebirds may be present in or fly through the region between July and December, and again between March and April as they complete migrations between Australia and offshore locations (Department of Environment, 2015). The risk associated with collision from seabirds and shorebirds attracted to the light is considered to be low, given the short duration of activities within Operational Area 1. Based on the intermittent and short duration of the activities in Operational Area 1, as well as the distance offshore, impacts are expected to be limited to temporary behavioural disturbance to isolated individuals, with no lasting effect or displacement from important habitat.

Operational Area 2 overlaps a foraging and breeding BIA for the wedge-tailed shearwater, and is approximately 39 km from the Muiron Islands, which is a significant breeding site for this species (Cannel et al., 2019). Adult shearwaters are vulnerable to artificial lighting during the breeding cycle, when returning to and leaving the nesting colony to maintain nesting sites or forage. Foraging wedge-tailed shearwaters may be attracted to sources of light emissions to feed on fish drawn to the light; however, the species feeds predominantly during the day (Catry et al., 2009; Whittow 1997). Artificial light can also impact behaviour and adult nest attendance, 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). Shearwater 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).

The breeding period for the wedge-tailed shearwater is from August to March, with peak incubation and chick rearing during November (Cannel et al., 2019). During this period, adults were observed taking a combination of short (1–4 days) or long (6–30 days) foraging trips from the Muiron Islands towards the north-west (Cannel et al., 2019). Operational Area 1 is within an area that is regularly used for short-distance foraging trips from Muiron Islands during chick rearing (Cannel et al., 2019); however, the peak of this foraging activity occurs during November, which does not overlap the planned timing of the activity (December–April). Impacts to wedge-tailed shearwaters is considered to be limited to negligible behavioural disturbance to isolated transient individuals, not significant to the population's presence in important breeding and foraging habitat. ***Other Marine Fauna*** Lighting from ROV or vessel/MODU activities in Operational Area 1 may result in the localised aggregation of fish around the ROV or below the vessel/MODU. These aggregations of fish due to light are considered localised and temporary. Any long-term changes to fish species composition or abundance is considered highly unlikely. Any localised impacts to marine fish are not expected to impact on any commercial fishers in the area. Krill or plankton may also aggregate around the source of light. These aggregations of fish, krill or plankton would be confined to a small area and would only occur when the ROV is in use. Based on the short duration and localised nature of the Petroleum Activities Program, these aggregations are not expected to attract pygmy blue whales, humpback whales or whale sharks.
Summary of Potential Impacts to environmental values(s)
Light emissions from project vessels/MODU will not result in an impact greater than a localised and temporary disturbance to fauna in the vicinity of Operational Area 1 with no lasting effect to any species.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[17]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Variation of the timing of the Petroleum Activities Program to avoid peak turtle nesting periods (December to March).	F: Yes. Avoidance of turtle nesting periods is technically feasible, although is not considered to be practicable. CS: Not considered – control not feasible.	Negligible or no reduction consequence given the distance of the nesting areas to the operational area.	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice for minimal environmental benefit.	No
Professional Judgement – Eliminate				
Restrict the Petroleum Activities Program to daylight hours, eliminating the need for external work lights	F: No. Components of the Petroleum Activities Program cannot safely be completed within a 12-hour day shift. As such, the need for external lighting cannot safely be eliminated. CS: Not considered – control not feasible	Not considered – control not feasible	Not considered – control not feasible	No
Professional Judgement – Substitute				
Substitute external lighting with "turtle friendly" light sources (reduced emissions in turtle visible spectrum)	F: Yes. Replacement of external lighting with turtle friendly lighting is technically feasible, although is not considered to be practicable.	Negligible or no reduction in likelihood (which is already remote), no	Grossly disproportionate. Implementation of the control requires	No

[17] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[17]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Significant cost sacrifice. The retrofitting of all external lighting on project vessels would result in considerable cost and time expenditure. Considerable logistical effort to source sufficient inventory of the range of light types.	reduction in consequence.	considerable cost sacrifice for minimal environmental benefit.	
Professional Judgement – Engineered Solution				
No additional controls identified.				

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the potential impacts from routine light emissions from project vessels/MODU within Operational Area 1 to be ALARP. This includes consideration of the intermittent nature of light emissions for the duration of the Petroleum Activities Program, and the requirements for external lighting for safe operations. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that routine light emissions from project vessels/MODU may result in impacts limited to temporary behavioural disturbance to fauna within a localised area and with no lasting effect on any species. BIAs within Operational Area 1 include a foraging and breeding BIA for wedge-tailed shearwaters. Further opportunities to reduce the impacts have been investigated above. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential impacts and the NLPG were taken into consideration during the impact evaluation. Therefore, Woodside considers standard operations appropriate to manage the impacts and risks of routine light emissions to a level that is broadly acceptable.

6.6.1.6 Routine Acoustic Emissions from Activities within Operational Area 1

Context	
Project Vessels – **Section 3.10** Helicopters – **Section 3.12**	Biological Environment – **Section 4.4**

Impacts and Risks Evaluation Summary

Source of Risk	Environmental Value Potentially Impacted: Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-economic	Evaluation: Decision Type	Consequence	ALARP Tools	Acceptability	Outcome
Generation of acoustic signals from project vessels (including DP) during operations within Operational Area 1.						X		A	F	LCS GP PJ	Broadly acceptable	N/A
Generation of atmospheric noise from helicopter transfers within Operational Area 1						X		A	F			

Description of Source of Risk

Project vessels and the MODU will generate noise both in the air and underwater, due to the operation of thruster engines, propeller cavitation, well intervention operations, on-board machinery etc. These noises will contribute to and have the potential to 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).

Well Intervention

A MODU may to be on location for up to 360 days (based on the estimated maximum time for intervention all 18 wells under this EP). The main sources of sound from a MODU include:

- machinery and drilling equipment (including pumps, compressor and generators)
- drilling on the seabed (during drilling the turntable will operate and the machinery will work at higher power)
- dynamic positioning thrusters (used for positioning; can generate high cavitating noise) (Genesis, 2011).

McCauley (1998) recorded source noise levels from 149–154 dB re 1 µPa at 1 m from a moored MODU while actively drilling (with support vessel on anchor), and Greene (1987) recorded source levels of two moored drill ships from 145–158 dB re 1 µPa at 1 m during drilling (with support vessels idling nearby).

Because no drilling will be undertaken during the Petroleum Activities Program, noise emitted by a moored MODU (if used) is expected to be at the lower end of this range. Furthermore, noise from a moored MODU is likely to be significantly lower than noise emitted by vessels or a MODU on DP. Noise from a MODU using DP is covered below.

Project Vessels and Operation of Dynamic Positioning Systems

The intervention vessel, PIV, activity support vessels, as well as potentially the MODU, may maintain DP for varying durations during the Petroleum Activities Program, depending on the activity the activity being undertaken. The main source of noise from a DP vessel/MODU relates to using DP thrusters. McCauley (1998) measured underwater broadband noise equivalent to approximately 182 dB re 1 µPa at 1 m (rms SPL) from an activity support vessel holding station in the Timor Sea; it is expected that similar noise levels will be generated by the intervention vessel, PIV, activity support vessels and MODU used for this Petroleum Activities Program.

Positioning Equipment

During well intervention activities, an array of long baseline and/or ultrashort transponders may be installed on the seabed for metrology and positioning. Transponders typically emit pulses of medium frequency sound, generally within the range 21 to 31 kHz. The estimated SPL would be 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al., 2017). Transmissions are not continuous but comprise short (3–40 millisecond) 'chirps'.

Transponders will not emit any sound when on standby. When required for general positioning, they will emit one chirp every five seconds (estimated to be required for four hours at a time). When required for precise positioning, they will emit one chirp every second (estimated to be required for two hours at a time). For well intervention activities, transponders may be active at the start of the activity where positioning is required, and will be recovered at the end of the activity.

Helicopter Transfers

Helicopter activities will occur in Operational Area 1, including landing and take-off on the vessel/MODU helidecks. Sound emitted from helicopter operations is typically below 500 Hz (Richardson et al., 1985). 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 was 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 was 108 dB re 1 µPa at 305 m (Simmonds et al., 2004).

Impact Assessment

Potential impacts to environmental values

Receptors

Operational Area 1 is located in waters >400 m deep. The fauna associated with this area will be predominantly pelagic species of fish, with migratory species such as turtles, whale sharks and cetaceans (**Section 4.4.3**) potentially present in the area seasonally (**Table 4-7**). Noise interference is a key threat to a number of migratory and threatened cetaceans and marine turtles identified as occurring within Operational Area 1. Relevant recovery plans, threat abatement plans and conservation advice for these species are outlined in **Table 4-4**; **Section 6.8** assesses relevant actions and objectives from applicable plans to demonstrate the Petroleum Activities Program is consistent with these plans.

Operational Area 1 does not overlap any habitat critical to the survival of a species; however, a humpback whale migration BIA and pygmy blue whale migration BIA do intersect the area. Pygmy blue whale individuals may occasionally transit Operational Area 1, with a higher likelihood of occurrence during April to August and October to January during their seasonal migrations. The possible foraging area BIA off North West Cape for pygmy blue whales and the resting BIA for humpback whales in Exmouth Gulf are located >30 km from Operational Area 1. Humpback whale migration periods occur during July (northbound) and late August/September to October (southbound). Turtles may also infrequently transit Operational Area 1; however, given water depths and distance from shore, the area does not constitute foraging or internesting habitat.

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):

- 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)
- by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)
- through disturbance leading to behavioural changes or displacement from important areas (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.

<u>Sound Propogation Calculations</u>

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

<u>Cetacean Thresholds</u>

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. These thresholds have been adopted by the United States (US) National Oceanic and Atmospheric Administration (NOAA) (National Marine Fisheries Service [NMFS], 2014).

Table 6-4: PTS and TTS onset thresholds

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	L_{pk}, flat: 219 dB L_E, LF, 24h: 183 dB	L_E, LF, 24h: 199 dB	L_{pk}, flat: 213 dB L_E, LF, 24h: 168 dB	L_E, LF, 24h: 179 dB	L_p 160 dB	L_p 120 dB

High-frequency cetaceans	L_{pk}, flat: 202 dB L_E, HF, 24h: 155 dB	L_E, HF, 24h: 173 dB	L_{pk}, flat: 196 dB L_E, HF, 24h: 140 dB	L_E, HF, 24h: 153 dB	L_p 160 dB	L_p 120 dB

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

Marine Turtles

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). No numerical thresholds have been developed for impacts of continuous sources (e.g. vessel noise) on marine turtles.

Project Vessel, MODU and Positioning Equipment Noise Impacts

Noise generated by the project vessels/MODU is expected to be limited to 182 dB re 1 µPa at 1 m (McCauley, 1998). The potential for received levels to exceed weighted thresholds defined for PTS or TTS for marine mammals is considered not credible due to propagation and reduction of sound from the source. Behavioural response thresholds for marine mammals are estimated to be exceeded out to about 7500 m from the project vessels/MODU on DP. Operational Area 1 is surrounded by open water, with no restrictions (such as shallow waters, embayments) on an animal's ability to avoid the activities.

Considering the overlap with or proximity of BIAs to Operational Area 1, there may be increased numbers of individuals of pygmy blue whales, humpback whales and other cetacean species within Operational Area 1 during migratory periods. Interactions between pygmy 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 Operational Area 1 is >30 km from the possible pygmy blue whale foraging BIA and humpback whale resting BIA, no impacts are predicted to occur from project vessel noise on individuals using these areas. In summary, potential impacts to pygmy 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.

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 from project vessels or the MODU are expected to be negligible. Other fauna associated with Operational Area 1 will be predominantly pelagic species of fish, with migratory species such as whale sharks and rays transiting through Operational Area 1; these species may be similarly affected by noise from project vessels/MODU.

Compliance with EPBC Regulation 2000 – Part 8 Interacting with Cetaceans to reduce the likelihood of collisions with cetaceans (i.e. vessels are to travel slower) may also further incidentally reduce the noise generated by vessels close to cetaceans and marine turtles—slower vessel speeds may reduce underwater noise. In summary, potential impacts from vessel noise are likely to be restricted to temporary avoidance behaviour of individuals transiting through Operational Area 1 with no lasting effect. Individuals foraging or migrating may deviate slightly from their activities or migration route, but are expected to continue on their migration pathway or resume normal behaviours as they move away from the activities.

Positioning Equipment Noise

Transponders used for positioning have the potential to cause some temporary behavioural disturbance to marine fauna; however, noise levels will be well below injury thresholds. Based on empirical spreading loss estimates measured by Warner and McCrodan (2011), received levels from ultra short baseline transponders are expected to exceed the cetacean behavioural response threshold for impulsive sources out to about 42 m. Given the short-duration chirps and the mid frequencies used by positioning equipment, the acoustic noise from a single transponder is unlikely to have any substantial effect on the behavioural patterns of marine fauna. Therefore, potential impacts from transponder noise are likely to be restricted to temporary and localised avoidance behaviour of individuals transiting through the Operational Area 1, and therefore are considered localised with no lasting effect.

Helicopter Noise Impacts

Helicopter engines and rotor blades are recognised as a source of noise emissions, which may result in behavioural disturbance to marine fauna. 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) – most 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 are almost entirely reflected (Richardson et al., 1995). Given this, and the typical characteristics of helicopter flights within Operational Area 1 (duration, frequency, altitude and air speed), the opportunity for underwater noise levels that may result in behavioural disturbance are considered to be highly unlikely. Note: Helicopter noise during approach, landing and take-off is more likely to propagate through the sea surface due to the reduced air speed and lower altitude. However, helicopter noise during approach, landing and take-off will be mingled with underwater noise generated by the facility hosting the helipad (e.g. thruster noise from vessels, machinery noise from MODU, etc.).

Additionally, approach, landing and take-off are relatively short phases of the flight, resulting in little opportunity for underwater noise to be generated. Given the standard flight profile of a helicopter transfer, maintenance of a more than 500 m horizontal separation from cetaceans (as per EPBC Regulations), and the predominantly seasonal presence of whales within Operational Area 1, interactions between helicopters and cetaceans that result in behavioural impacts are considered to be highly unlikely. In the highly unlikely event that cetaceans are disturbed by helicopters, responses are expected to consist of short-term behavioural responses, such as increased swimming speed; the consequence of such disturbance is considered to have no lasting effect. Although unlikely, turtles may be present in low numbers within Operational Area 1 and may be exposed to helicopter noise when on the sea surface (e.g. when basking or breathing). Typical startle responses occur at relatively short ranges (tens of metres) (Hazel et al., 2007) and, as such, startle responses during typical helicopter flight profiles are considered remote. If a turtle has a behavioural response to the presence of a helicopter, it is expected to exhibit diving behaviour, which has no lasting effect. Operational Area 1 may be occasionally visited by migratory and oceanic birds but the area does not contain any emergent land that could be used as roosting or nesting habitat. The closest emergent land is 32 km south (North West Cape). One BIA, a breeding area for wedge-tailed shearwaters, overlaps Operational Area 1 (August to April). However, there are no nesting sites such as islands within or near Operational Area 1. Given the expected low density of seabirds within Operational Area 1 due to a lack of roosting or nesting habitat, the relative infrequency of helicopter flights and lack of lasting effect of potential behavioural responses to helicopter noise, impacts would be unlikely, localised and temporary, and result in no lasting effect.
Summary of Potential Impacts to environmental values(s)
It is considered that noise generated by project vessels (including MODU, primary installation vessels and support vessels), helicopters and positioning transponders will not result in a potential impact greater than localised impacts, with no lasting effect.

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				
No additional controls identified.				
Good Practice				
The use of dedicated Marine Fauna Observers (MFOs) on project vessels for the duration of the Petroleum Activities Program to watch for whales and provide direction on and monitor compliance with Part 8 of the EPBC Act Regulations.	F: Yes. However, activity support vessel bridge crews already maintain a constant watch during operations in compliance with the Woodside Marine – Charterers Instructions, on the requirements of vessel and whale interactions. In the event of a cetacean (or other sensitive fauna) in close proximity to project vessels, it is unlikely that DP (the most significant source of underwater noise expected during the Petroleum Activities Program) will be deactivated given it is a safety critical requirement for project vessels to hold station. As such, an MFO implementing management / shut down zones is considered to be ineffective.	Given that support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not further reduce the likelihood or consequence of impact.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No

[18] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[18]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Additional cost of MFOs			
Undertake site-specific acoustic modelling	F: Yes it is feasible to undertake site-specific modelling; however, the generation of noise from these sources is already well understood and this noise cannot be eliminated due to operating requirements. CS: Additional cost of modelling	Given that noise cannot be eliminated due to operating requirements, modelling would not further reduce the likelihood or consequence of impact, noting that no activities of significant noise generation (i.e. explosives) are proposed.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Eliminate				
Remove activity support vessel on standby at the Petroleum Activities Program location.	F: No. Activity support vessel required for safety reasons, particularly for maintaining the 500 m exclusion zone around the MODU / intervention vessel and PIV. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Elimination of noise from the MODU, primary installation vessels, support vessels or survey positioning equipment.	F: No. The generation of noise from these sources cannot be eliminated due to operating requirements. Note: Operating vessels on DP may be a safety critical requirement. CS: Inability to conduct the Petroleum Activities Program. Loss of project.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Avoid peak migration periods for migratory cetaceans.	F: Yes. Migration periods for cetaceans that may occur in the Operational Area (pygmy blue and humpback whales) are well known. CS: Potentially significant. Woodside has not finalised the schedule for the Petroleum Activities Program, and some activities may be undertaken on an opportunistic basis and in succession to one another while a vessel is available. Precluding operations during cetacean migration periods may impose a considerable cost and operational burden, while resulting in little environmental benefit.	Avoiding migration periods would reduce the likelihood of impacts to cetaceans. However, given that the predicted noise levels are not considered to be ecologically significant at a population level, the overall benefit is minimal.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Engineered Solution				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the potential impacts from noise generated from project vessels and helicopters to be ALARP. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that project vessels (including MODU, PIV, and support vessels), helicopters and positioning transponder noise disturbance is unlikely to result in a potential impact greater than localised behavioural impacts. These effects are not significant to marine fauna, and have no lasting effect. BIAs within the Operational Area include the humpback whale migration BIA and the pygmy blue whale migration BIA. Further opportunities to reduce the impacts have been investigated above. As demonstrated in **Section 6.8**, the residual impacts of routine acoustic emissions from project vessels and the MODU in Operational Area 1 are not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans. Regard has been given to relevant conservation advice during the assessment of potential impacts. Therefore, Woodside considers standard operations appropriate to manage the impacts of noise from project vessels and helicopters to a level that is broadly acceptable.

6.6.1.7 Routine and Non-routine Atmospheric Emissions from Activities within Operational Area 1

Context	
Well Intervention– **Section 3.9** RTM Removal – **Section 3.6** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3**

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***	***ALARP Tools***	***Acceptability***	***Outcome***
Exhaust emissions from internal combustion engines and incinerators on project vessels and helicopters within Operational Area 1				X				A	F	LCS GP PJ	Broadly acceptable	EPO 8 and 9
Bleed off of hydrocarbon gas during well intervention				X				A	F			

Description of Source of Risk

Internal combustion engines and incinerators

Atmospheric emissions will be generated by the project vessels from internal combustion engines (including all equipment and generators) during the Petroleum Activities Program. Emissions will include SO_2, NO_x, ozone depleting substances, CO_2, particulates and volatile organic compounds (VOCs).

Bleed off of hydrocarbon gas during well intervention

During well intervention activities, hydrocarbon gas may be released from the well. In the event that gas is released from the well, the gas may bubble to the sea surface (if released at the seabed) or be vented from the MODU (if well intervention undertaken by a MODU). Gas vented via the MODU will not be flared.

Impact Assessment

Potential impacts to environmental values

Fuel combustion has the potential to result in localised, temporary reduction in air quality. Potential impacts include a localised reduction in air quality, generation of dark smoke and contribution to greenhouse gas emissions. Given the short duration and exposed location of project vessels (which will lead to the rapid dispersion of the low volumes of atmospheric emissions), the potential impacts are expected to be localised and of no lasting effect.

Venting of hydrocarbon gases may result in a short-lived localised gas plume and a minor contribution to greenhouse gas emissions. There is potential for human health effects for workers in the immediate vicinity of atmospheric emissions. However, the closest sensitive residential receptor is the town of Exmouth, approximately 47 km south-east of the Operational Area; therefore any risks associated with off-site human health effects are negligible beyond the immediate zone of release and dispersion.

Given the short duration and isolated location of the Petroleum Activities Program (which will lead to the rapid dispersion of the low volumes of atmospheric emissions) the potential impacts are expected to be localised and of no lasting effect.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that the release of a small volume of greenhouse gases will not result in a potential impact greater than a temporary impact to local air quality with no lasting effect.

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				
Marine Order 97 (Marine Pollution Prevention – Air Pollution).	F: Yes CS: Minimal cost	Legislative requirements to be followed may slightly reduce the likelihood of air pollution.	Control based on legislative requirements – must be adopted	Yes C 8.1
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP).	F: Yes CS: Minimal cost. Standard practice.	The accepted WOMP will manage the risk of well kicks, reducing the likelihood of occurrence. No reduction in consequence will occur.	Control based on legislative requirements – must be adopted	Yes C 9.1
Good Practice				
Woodside Engineering Standards Well Barriers specifies the process to be undertaken to maintain an overbalance on the reservoir during well intervention .	F: Yes CS: Minimal cost. Standard practice for Woodside activities	Implementing equipment and procedures will reduce the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes C 9.2
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the potential impacts of release of atmospheric emissions within Operational Area 1. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, atmospheric emissions during the Petroleum Activities Program will not result in a potential impact greater than a temporary decrease in local air quality with low impact to the environment or human health and no lasting effects. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of the described emissions within Operational Area 1 to a level that is broadly acceptable.

[19] Qualitative measure

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 8 Fuel combustion emissions and incineration during the Petroleum Activities Program will be in compliance with marine order requirements to restrict emissions to those necessary to perform the activity.	**C 8.1** Marine Order 97 (Marine Pollution Prevention – Air Pollution).	**PS 8.1** MODU and project vessels compliant with Marine Order 97 (marine pollution prevention – air pollution) to restrict emissions to those necessary to perform the activity. Vessel marine assurance process conducted prior to contracting vessels, to ensure suitability and compliance with vessel combustion certification/ Marine Order requirements.	**MC 8.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 97.
EPO 9 No unplanned emissions to air as a result of venting from well.	**C 9.1** Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP).	**PS 9.1** Wells managed in compliance with the accepted WOMP, including implementation of barriers to prevent a loss of well integrity.	**MC 9.1.1** Acceptance letter from NOPSEMA demonstrates the WOMP was accepted by NOPSEMA prior to the well intervention commencing.
			MC 9.1.2 Records demonstrate WOMP has been implemented
	C 9.2 Woodside Engineering Standards Well Barriers specifies the process to be undertaken to maintain an overbalance on the reservoir during well intervention.	**PS 9.3** Well intervention compliant with internal Woodside Standards and international requirements (API Standard 53 4th Edition) as agreed by Woodside and MODU Contractor.	**MC 9.3.1** Records demonstrate that control system specifications were in accordance with minimum standards for the expected conditions and maintain well control.

6.6.2 Unplanned Activities (Accidents, Incidents, Emergency Situations)

6.6.2.1 Quantitative Spill Risk Assessment Methodology

Stochastic Modelling

Quantitative hydrocarbon spill modelling was undertaken by RPS Asia Pacific Applied Science Associates (RPS APASA), on behalf of Woodside, using a three-dimensional hydrocarbon spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of changing meteorological and oceanographic forces.

A stochastic modelling scheme was followed in this study, whereby SIMAP was applied to repeatedly simulate the defined credible spill scenarios using different samples of current and wind data. These data samples were selected randomly from an historic time-series of wind and current data representative of the study area. Results of the replicate simulations were then statistically analysed and mapped to define contours of percentage probability of contact at identified thresholds around the hydrocarbon release point.

The model simulates surface releases and uses the unique physical and chemical properties of a representative hydrocarbon type to calculate rates of evaporation and viscosity change, including the tendency to form oil-in-water emulsions. Moreover, the unique transport and dispersion of surface slicks and in-water components (entrained and dissolved) are modelled separately. Thus, the model can be used to understand the wider potential consequences of a spill, including direct contact of hydrocarbons due to surface slicks (floating hydrocarbon) and exposure of organisms to entrained and dissolved aromatic hydrocarbons in the water column.

During each simulation, the SIMAP model records the location (by latitude, longitude and depth) of each of the particles (representing a given mass of hydrocarbons) on or in the water column, at regular time steps. For any particles that contact a shoreline, the model records the accumulation of hydrocarbon mass that arrives on each section of shoreline over time, less any mass that is lost to evaporation and/or subsequent removal by current and wind forces.

The collective records from all simulations are then analysed by dividing the study region into a three-dimensional 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 hydrocarbons spill modelling assessments undertaken by RPS APASA 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.

Hydrocarbon Characteristics

As part of the risk identification process, Woodside identified the range of credible hydrocarbon spill scenarios that may occur from the Petroleum Activities Program. These scenarios are considered in the risk assessments of accidental hydrocarbon spill scenarios (**Sections 6.7.2.2** and **6.7.2.3**), and include:

- uncontrolled release to the marine environment during well intervention activities resulting in ~14,456 m³ of Enfield crude released for 77 days from the Enfield ENA01 production well location within Operational Area 1. This includes five days of surface release (1177 m³) and 62 days of subsea release (13,279 m³). This is considered the worst case scenario from a loss of well integrity

- uncontrolled subsea release to the marine environment during well intervention from an oil production well following accidental damage to, or removal of, the subsea Xmas tree due to MODU anchor drag within Operational Area 1
- two vessel collision scenarios resulting in about 500 m³ of marine diesel instantaneously released from both Operational Area 1 and Operational Area 2
- a bunkering incident scenario resulting in about 8 m³ of diesel instantaneously released (note that bunkering will only occur within Operational Area 1)

Woodside has undertaken physical and ecotoxicology testing on Enfield crude, which is the hydrocarbon that can credibly be released from a loss of well containment event. The physical characteristics of Enfield crude, along with marine diesel, as used in the hydrocarbon spill modelling studies, are provided in **Table 6-5**.

Table 6-5: Hydrocarbon characteristics

Hydrocarbon Type	Initial Density (g/cm³)	Viscosity (cP)	Component BP (°C)	Volatiles <180 °C	Semi volatiles 180–265 °C	Low Volatility (%) 265–380 °C	Residual (%) >380 °C	Aromatic (%) of whole oil <380 °C BP
				Non-Persistent			Persistent	
Enfield crude	0.921 @ 15 °C	46.022 @ 20 °C	% of total	2.6	15.6	43.4	38.4	13.5
			% aromatics	0.1	1.4	12.0	-	-
Marine diesel	0.829 @ 25 °C	4.0 @ 25 °C	% of total	6.0	34.6	54.4	5.0	3.0
			% aromatics	1.8	1.0	0.2	-	-

Environment That May Be Affected and Hydrocarbon Contact Thresholds

The outputs of the quantitative hydrocarbon spill modelling were used to assess the environmental consequence, if a credible hydrocarbon spill scenario occurred, in terms of delineating which areas of the marine environment could be exposed to hydrocarbon levels exceeding hydrocarbon threshold concentrations. The summary of all the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the EMBA.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean transport mechanisms, the EMBA combines the potential spatial extent of the different fates. The EMBA also includes areas that are predicted to experience shoreline contact with hydrocarbons above threshold concentrations.

The EMBA covers a larger area than the area that is likely to be affected during any single spill event, as the model was run for a variety of weather and metocean conditions, and the EMBA represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs. Furthermore, as the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean transport mechanism, a different EMBA is presented for each fate. These EMBA together define the spatial extent for the existing environment, which is described in **Section 4**. Hydrocarbon contact below the defined thresholds may occur outside the EMBA and socio-cultural EMBA; however, the effects of these low exposure values will be limited to temporary exceedance of water quality triggers. The area within which this may occur in the event of a worst-case credible spill is presented in **Appendix D**: Figure 5-1.

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—adopting accepted contact thresholds that are documented to impact the marine environment—is used to define the EMBA.

Hydrocarbon thresholds are presented **Table 6-6** and described in the following subsections.

Table 6-6: Summary of thresholds applied to the quantitative hydrocarbon spill risk modelling results

Hydrocarbon Type	EMBA				Socio-cultural EMBA
	Surface Hydrocarbon (g/m^2)	Entrained hydrocarbon (ppb)	Dissolved aromatic hydrocarbon (ppb)	Accumulated hydrocarbons (g/m^2)	Surface Hydrocarbon (g/m^2)
Crude	10	100	50	100	1
Diesel	10	500	500	100	-

Surface Hydrocarbon Threshold Concentrations

The spill modelling outputs defined the EMBA for surface hydrocarbon spills (contact on surface waters) using the ≥10 g/m^2 threshold (dull metallic colours) based on the relationship between film thickness and appearance (Bonn Agreement, 2015) (**Table 6-7**). This threshold concentration, expressed in terms of g/m^2, is geared towards informing potential oiling impacts for wildlife groups and habitats that may break through the surface slick from the water or the air (e.g. emergent reefs, vegetation in the littoral zone and air-breathing marine reptiles, cetaceans, seabirds and migratory shorebirds).

Thresholds for registering biological impacts resulting from contact of surface slicks have been estimated by different researchers at about 10–25 g/m^2 (French et al., 1999; Koops et al., 2004; NOAA, 1996; French-McCay, 2018). Potential impacts of surface slick concentrations in this range for floating hydrocarbons may include harm to seabirds through ingestion from preening of contaminated feathers, or the loss of the thermal protection of their feathers. The 10 g/m^2 threshold is the reported level of oiling to instigate impacts to seabirds, and is also applied to other wildlife, although it is recognised that 'unfurred' animals (where hydrocarbon adherence is less) may be less vulnerable. 'Oiling' at this threshold is taken to be of a magnitude that can cause a response from the most vulnerable wildlife such as seabirds. Due to weathering processes, surface hydrocarbons have a lower toxicity due to changes in their composition over time. Potential impacts to shoreline sensitive receptors may be markedly reduced in instances where there is extended duration until the slick contacts the shoreline.

Woodside recognises that hydrocarbons may be visible at low concentrations of approximately 1 g/m^2. Therefore, the threshold for visible surface oil (1 g/m^2) was used to define an additional boundary within which socio-cultural impacts to the visual amenity of the marine environment may occur. This area is referred to as the socio-cultural EMBA. Any ecological impacts from dissolved and entrained hydrocarbons above prescribed thresholds, as in **Table 6-6**, may also result in socio-cultural impacts. Potential impacts to socio-cultural values assessed within these EMBAs include the following:

- protected areas
- National and Commonwealth Heritage Listed places
- tourism and recreation
- fisheries.

The boundaries of the two EMBAs may differ due to the different thresholds, hydrodynamics and weathering of the released hydrocarbons.

Table 6-7: The Bonn Agreement oil appearance code

Appearance (following Bonn visibility descriptors)	Mass per area (g/m^2)	Thickness (μm)	Volume per area (L/km^2)
Discontinuous true oil colours	50 to 200	50 to 200	50,000 to 200,000
Dull metallic colours	5 to 50	5 to 50	5000 to 50,000
Rainbow sheen	0.30 to 5.00	0.30 to 5.00	300 to 5000
Silver sheen	0.04 to 0.30	0.04 to 0.30	40 to 300

Dissolved Aromatic Hydrocarbon Threshold Concentrations

Enfield crude

The hydrocarbon threshold concentration value for dissolved aromatic hydrocarbons (i.e. 50 ppb) is considered conservative and has been set with reference to the dissolved exposure values detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019), and in context of ecotoxicity tests results from Enfield Crude.

The purpose of the threshold is to inform the assessment of the potential for toxicity impacts to sensitive marine biota. The ecotoxicity tests were undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well established. These ecotoxicology tests are focused on the early life stages of test organisms, when organisms are typically at their most sensitive. The ecotoxicology tests were conducted on six mainly tropical-subtropical species representatives from six major taxonomic groups.

The ecotoxicity testing of the Enfield crude (**Table 6-5)** focuses on the total petroleum hydrocarbon (TPH) concentration of the water accommodated fractions (WAF) of the hydrocarbon and includes the carbon chains C6 to C36. Typically, C4 to C10 compounds are volatile (BP <180 °C), C11 to C15 compounds are semi-volatile (BP 180–265 °C), C16 to C20 compounds have low volatility (265–380 °C) and C21 compounds and above are residual (BP >380 °C).

The laboratory-based ecotoxicology tests used a range of WAF concentrations to expose the different test organisms. For each ecotoxicity test, samples of the WAF were analysed to determine the TPH concentration of the solution. **Table 6-8** presents the results of no observed effect aromatic concentrations (NOECs) for Enfield crude WAFs tested. The range of NOECs for the organisms tested ranged from 340 ppb to 3512 ppb. Tests with a NOEC below the set threshold were the sea urchin fertilisation and microalgal growth tests. These tests indicated acute and chronic effects at dissolved aromatic concentrations less than 500 ppb (NOEC: >340 ppb), toxicity test results on all other test organisms found no observed effects at concentrations above 500 ppb.

Table 6-8 shows the range of the no observable effect (NOEC) total petroleum hydrocarbons (TPH) concentrations for Enfield crude water accomodated fractions (WAFs) tested. The 50 ppb threshold is significantly below the NOEC for all six sensitive organisms tested and is considered to be conservative

Table 6-8: Summary of total TPH NOECs for key life-histories of different biota based on toxicity tests for WAF of Enfield crude oil

Biota and Life Stage	Exposure duration	NOEC – TPH concentration of Enfield crude showing no direct biological effect (ppb)
Sea urchin fertilisation	1 hour	340
Sea urchin larval development	72 hours	838
Milky oyster larval development	48 hours	1550
Micro-algal growth test	72 hours	350
Amphipod acute toxicity test	72 hours	828

Biota and Life Stage	Exposure duration	NOEC – TPH concentration of Enfield crude showing no direct biological effect (ppb)
Tropical copepod acute toxicity test	96 hours	640
Larval fish imbalance test	96 hours	3512

Source: Ecotox Services Australia, 2009

Marine diesel

The dissolved aromatic threshold of 500 ppb for diesel has been selected as a conservative threshold to be consistent with the NERA Environment Plan Reference Case: Consequence analysis of an accidental release of diesel (2018:1003; National Energy Resources Australia [NERA], 2018). A threshold of 500 ppb is recommended in the reference case in accordance with a review by IRC (2011) of Group II (Marine Gas Oil [MGO]) hydrocarbon toxicity to the marine environment (NERA, 2018). A contact threshold of 500 ppb was found to be conservative for a range of species including crustaceans, molluscs, echinoderms and fish. Five out of six indicator species in ecotoxicology testing showed no observed effect from hydrocarbons below this concentration.

Entrained Hydrocarbon Threshold Concentrations

The spill modelling outputs are used to define the EMBA by defining the spatial variability of entrained hydrocarbons above a set concentration threshold contacting sensitive receptors (expressed in ppb).

Entrained hydrocarbons present a number of possible mechanisms for toxic exposure to marine organisms. The entrained hydrocarbon droplets may contain soluble compounds, hence have the potential for generating elevated concentrations of dissolved aromatic hydrocarbons (e.g. if mixed by breaking waves against a shoreline). Physical and chemical effects of the entrained hydrocarbon droplets have also been demonstrated through direct contact with organisms, for example through physical coating of gills and body surfaces, and accidental ingestion (National Research Council 2005).

Condensate

The condensate threshold concentration value for entrained hydrocarbons (i.e. 100 ppb) is considered conservative and has been set with reference to the entrained exposure values detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019), and in context of ecotoxicity tests results from the Enfield Crude.

The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for WAF of oil hydrocarbons (**Table 6-8**). However, it is likely these data specific to dissolved oil hydrocarbon represents a worst-case scenario. This is owing to the fact that entrained oil hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved oil hydrocarbons. It is therefore expected that the entrained threshold concentration of 100 ppb will represent a potential impact substantially lower than the NOEC concentrations presented in **Table 6-8** and is therefore considered to be conservative.

Marine diesel

The entrained threshold for diesel has been selected to be consistent with the NERA Environment Plan Reference Case: Consequence analysis of an accidental release of diesel (2018:1003; NERA 2018). As described above, entrained droplets may contain soluble compounds and hence have the potential for generating elevated concentrations of dissolved hydrocarbons. However, the potential for physical and chemical effects from direct contact with entrained oil droplets, which are less biologically available, is more applicable. An entrained threshold of 500 ppb, consistent with the threshold for toxicity from dissolved components, is therefore considered to be conservative.

Accumulated Hydrocarbon Threshold Concentrations

Owens and Sergy (1994) define accumulated hydrocarbon <100 g/m^2 to have an appearance of a stain on shorelines. French-McCay (2009) defines accumulated hydrocarbons ≥100 g/m^2 to be the threshold that could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat. A threshold of ≥100 g/m^2 has therefore been adopted to define the EMBA for both a condensate and diesel spill. Further, any ecological impacts at the accumulated thresholds concentration EMBA may also result in socio-cultural impacts.

Scientific Monitoring

A planning area for scientific monitoring is also described in Section 5.7 of the Oil Spill Preparedness and Response Mitigation Assessment (**Appendix D**). This planning area has been defined with reference to the low exposure entrained value of 10 ppb detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019). This low exposure threshold is based on the potential for exceeding water quality triggers.

A scientific monitoring program would be activated following a Level 2 or 3 unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. This would consider receptors at risk (ecological and socio-economic) for the entire predicted EMBA and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the worst-case credible spill scenario(s) or other identified unplanned hydrocarbon releases associated with the operational activities.

6.6.2.2 Unplanned Hydrocarbon Release: Loss of Well Containment during Intervention Activities within Operational Area 1

Context		
Well Intervention – **Section 3.9** Disturbance to Seabed from Dropped Objects – **Section 6.6.2.9**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4** Socio-economic – **Section 4.5** Values and Sensitivities – **Section 4.6**	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***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Loss of hydrocarbons to marine environment due to loss of well containment during well intervention within Operational Area 1	X	X	X	X	X	X	X	B	B	2	H	LCS GP PJ RBA CV SV	Acceptable	EPO 9 and 10

Description of Source of Risk

Background

Woodside has identified a well blowout as the scenario with the worst-case credible environmental outcome as a result of loss of well containment. A loss of well containment is an uncontrolled release of reservoir hydrocarbon or other well fluids to the environment. A blowout is an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers (e.g. the BOP) or activation of the same has failed.

Industry Experience

A risk assessment by AMSA of oil spills in Australian ports and waters (Det Norske Veritas 2011) concluded that:

- overall national exceedance frequency for oil spills from offshore drilling in Australia is 0.033 for spills > 1 tonne/year decreasing to 0.008 for spills > 100 tonnes/year
- probability of a blow-out from a well intervention is 1 x 10^{-4} (0.0001, or 0.01%), considerably lower than drilling activities (International Association of Oil and Gas Producers 2010).

Woodside has a good history of implementing industry standard practice in well design and construction. In the company's 60 year history, it has not experienced any well containment events that have resulted in significant releases or significant environmental impacts.

Therefore, in accordance with the Woodside Risk Matrix, a loss of well containment and resulting blowout event corresponds to an 'unlikely' event as it has occurred many times in the industry, but not in the Company.

Credible Scenario – Loss of Well Containment during Intervention

Multiple wells may be intervened during the Petroleum Activities Program if a suitable opportunity (e.g. MODU of convenience) arises during the Petroleum Activities Program. The well intervention involves re-establishing barriers via a MODU or intervention vessel. The credible scenario to be considered during well intervention is uncontrolled release to environment during well intervention.

Note: Other credible loss of well containment scenarios not associated with well intervention are considered in **Section 6.6.2.3**.

Note: The loss of well containment scenario is considerably smaller in volume (<29% of the total volume over 77 days) than was presented in the NGA Facility Operations EP. This is due to reservoir depletion resulting in an increased water cut and decreased reservoir pressure. Consequently, the nature and scale of the spill scenarios and associated EMBAs are considerably different.

Quantitative Hydrocarbon Spill Modelling – Loss of Well Containment

Spill modelling was undertaken by RPS APASA, on behalf of Woodside, to determine the fate of hydrocarbon released from the loss of well containment scenario, based on the assumptions in **Table 6-9**. The release rate provided assumes a release from the Nganhurra's highest producing well (ENA01), which has a 95% water cut (as per the latest reservoir testing). Modelling considered metocean conditions throughout the year; this was done to inform the determination of consequence of loss of well control during intervention at any time of the year.

Table 6-9: Summary of modelled credible scenario – loss of well containment during intervention

Parameter	***Loss of well containment[20]***
Total discharge at surface[21]	5 days 1177 m^3
Total discharge at Seabed	72 days 13,279 m^3
Water Depth	522.3 m
Fluid	Enfield Crude

Hydrocarbon Characteristics

The characteristics of the Enfield Crude oil are presented in **Table 6-5**.

Enfield crude oil will have a tendency to persist on the sea surface, with negligible levels of entrainment and only around 15% of the spilled volume expected to evaporate with the first 24 hours under light winds. Biological and photochemical degradation is predicted to contribute to the decay of the floating slicks at an approximate rate of 2% per day, for an accumulated total of about 15% after seven days. Adding to this the loss through evaporation (2–25%) and entrained/dissolved losses (around 5%) indicates that the proportion of oil remaining afloat will be around 55–60% after seven days under both light and moderate winds.

The bulk of the spilled mass of Enfield Crude that does not evaporate with the first 48 hours will be expected to remain floating on the water surface. Some components of the remaining oil will evaporate and/or degrade over time scales of several weeks to a few months.

[20] The discharge volumes in this table are predicted using reservoir modelling software packages that take into account a number of factors (well design, reservoir properties and environmental conditions (e.g. water depth, temperature and pressure) to provide a production profile over the oil spill modelling period.

[21] The worst-case credible spill scenario was identified as a well loss of containment occurring during well intervention with the use of a riser. If riseless well intervention is undertaken, the spill would be restricted to a 77-day subsea release, with no surface release. Given this and that the total release rate would be lower under a riserless scenario, the modelling conducted is considered to also conservatively represent this alternative scenario.

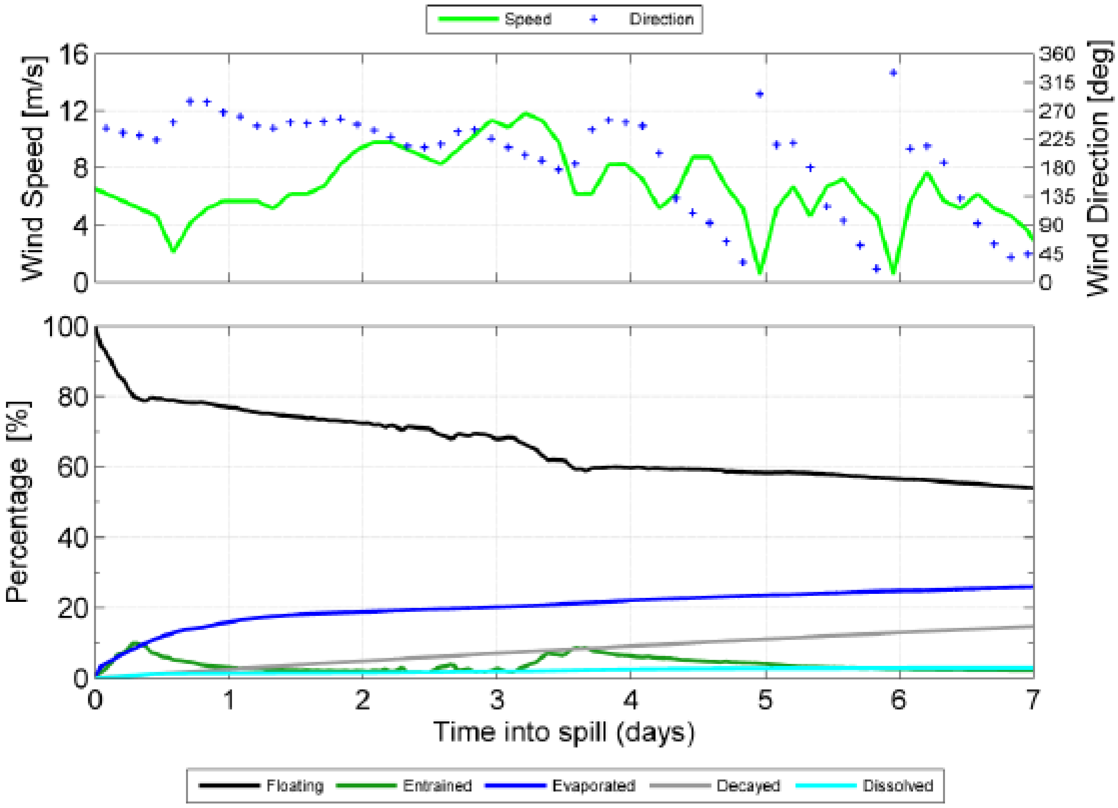

Figure 6-1: Proportional mass balance plot representing the weathering of Enfield crude spilled onto the water surface as a one-off release (50 m^3 over one hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature

Subsea Plume dynamics

The well blowout surface/subsea release that has been modelled forecasts the size of the hydrocarbon droplets that would be released from the well as determined by the OILMAP-Deep model. **Table 6-10** shows a summary of the results of the OILMAP Deep modelling for the well blowout.

Table 6-10: Near-field blowout model parameters for loss of well containment

OILMAP	Parameter	Value
Inputs	Release Depth (m BMSL)	522.3
	Oil Density (g/cm^3) (at 15 °C)	0.921
	Oil Viscosity (cP (at 20 °C)	46.022
	Oil Temperature (°C)	68.0
	Gas:Oil Ratio (scf/bbl)	2,101
	Oil Flow Rate (bbl/d) [m^3/d]	1160 [184.4]
	Diameter of Hole (m) [in]	0.157 [6.184]
Outputs	Plume Diameter (m)	25.3
	Plume Height (m ASB)	114.8
	Plume Initial Rise Velocity (m/s)	0.8
	Plume Terminal Rise Velocity (m/s)	0.0
Predicted Oil Droplet Size Distribution	9.7% droplets size (µm)	1,666.7
	17.6% droplets size (µm)	3,333.3
	20.2% droplets size (µm)	5,000.0
	19.9% droplets size (µm)	6,666.7

	17.8% droplets size (µm)	8,333.3
	14.8% droplets size (µm)	10,000.0

The results of the OILMAP simulation predicted that the discharge would generate a cone of rising gas that would entrain the oil droplets and ambient seawater up to a "trapping depth" (where the gas plume becomes neutrally buoyant and its vertical velocity drops to zero) approximately 115 m above the seabed and 407 m below the surface. The mixed plume is initially forecast to accelerate towards the water surface with a vertical velocity of 0.8 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone at the neutral buoyancy point is predicted to be approximately 25 m.

The discharge velocity and turbulence generated by the expanding gas plume is predicted to produce large oil droplets, of diameter ranging from 11,667–10,000 µm, which will rise to the surface at rates determined by their buoyancy relative to the surrounding water density and the viscous resistance imposed by the water. These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. With theoretical rise velocities ranging from 4.1–11.6 cm/s, the surfacing times with range from approximately 1–3 hours in the absence of turbulence or strong stratification of the water column. Floating slicks are likely to be formed under calm wind conditions.

The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present on the ocean surface, with the oil's high in viscosity meaning it will tend to resist entrainment under typical local wind conditions.

Impact Assessment

Potential impacts to environmental values

EMBA

Quantitative hydrocarbon spill modelling results are shown in **Table 6-11** and have been used to define the EMBA (**Sections 4.1** and **6.6.2.1**).

Surface Hydrocarbons

Quantitative hydrocarbon spill modelling results for surface hydrocarbons are shown in **Figure 4-1**. In the event of the loss of well containment scenario occurring, surface hydrocarbons at or above 1 g/m^2 are forecast to potentially occur up to 750 km from the release site. The oil slick is forecast to drift in all directions, reflecting the competing influence of both surface currents and winds across the wide area in which a large and persistent slick could travel over the long duration of the release, with higher-probability trajectories reaching the Ningaloo Coast (**Table 6-11**). At the surface threshold of 10 g/m^2, floating oil is forecast to potentially occur up to 100 km from the release site.

Entrained Hydrocarbons

Quantitative hydrocarbon spill modelling results for entrained hydrocarbons are shown in **Figure 4-1**. The most likely direction of drift is south-westerly around the Ningaloo Coast and then southwards, 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. The probability of contact by entrained oil at concentrations above 100 ppb is predicted to be 20% at both Ningaloo Coast North WHA and Ningaloo Coast Middle WHA, and 3% at Ningaloo Coast South WHA, and 1% at Shark Bay, Montebello Islands AMP, Abrolhos Islands AMP and the Gascoyne AMP (**Table 6-11**).

The cross-sectional transects of maximum entrained oil concentrations in the vicinity of the release site indicate a zone of low concentrations (<500 ppb) in the upper 200 m of the water column, representing the oil droplets rising from the trapping depth. Concentrations above 1000 ppb are only found in the upper 20 m within around 30 km of the release site, the result of wind- and wave-induced mixing entraining portions of the floating slicks. This process will also occur at greater distances, but with thinner floating slicks and lower concentrations.

Dissolved Hydrocarbons

Quantitative hydrocarbon spill modelling results for dissolved hydrocarbons are shown in **Figure 4-1**. Contact above the 50 ppb threshold was restricted to receptors associated with Ningaloo Reef (>10% probability) and the Gascoyne AMP (29% probability). The worst-case dissolved aromatic hydrocarbon concentrations reaching receptors are forecast at Gascoyne AMP (807 ppb), followed by Ningaloo Coast North WHA (191 ppb) (**Table 6-11**).

The cross-sectional transects of maximum dissolved aromatic hydrocarbon concentrations in the vicinity of the release site show how concentrations, in general, are forecast to be below 200 ppb, and insignificant below a depth of around 75 m. This reflects dissolution of aromatic compounds in the wave-mixed surface layer during infrequent entrainment events.

Accumulated Hydrocarbons

Quantitative hydrocarbon spill modelling results for maximum local accumulated hydrocarbon concentrations indicated that the following sensitive receptors have potential to experience shoreline accumulation above threshold concentrations (100 g/m^2); Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands Group, Pilbara Southern Island Group, Rankin Bank, Rowley Shoals (Clerke and Imperieuse Reef), Abrolhos Islands and Shark Bay (including the WHA), and areas along the Indonesian coastline (**Table 6-11**).

The largest potential volume of oil accumulating on any shoreline is expected to be 692 m^3 at Ningaloo Coast North. Large potential volumes are also forecast at Barrow and Lowendal Island (413 m^3).
Summary of Potential Impacts to environmental values(s)
Table 6-11 presents the full extent of the EMBA, i.e. the sensitive receptors and their locations that may be exposed to hydrocarbons (surface, entrained and dissolved) at or above the set threshold concentrations in the unlikely event of a major hydrocarbon release from 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 presented in the following sections.

Table 6-11: EMBA – Key receptor locations and sensitivities with the summary hydrocarbon spill contact for a 77-day subsea blowout of Enfield crude

Environmental setting	Location / name	Physical – Water Quality: Open water – (pristine)	Physical – Sediment Quality: Marine Sediment – (pristine)	Biological – Marine Primary Producers: Coral reef	Biological – Marine Primary Producers: Seagrass beds / Macroalgae	Biological – Marine Primary Producers: Mangroves	Biological – Other Communities / Habitats: Spawning/nursery areas	Biological – Other Communities / Habitats: Open water – Productivity/upwelling	Biological – Other Communities / Habitats: Non biogenic coral reefs	Biological – Other Communities / Habitats: Offshore filter feeders and/or Deepwater benthic communities	Biological – Other Communities / Habitats: Nearshore filter feeders	Biological – Other Communities / Habitats: Sandy shores	Biological – Other Communities / Habitats: Estuaries / tributaries / creeks / lagoons (including mudflats)	Biological – Other Communities / Habitats: Rocky shores	Biological – Protected Species: Cetaceans – migratory whales	Biological – Protected Species: Cetaceans – dolphins and porpoises	Biological – Protected Species: Dugongs	Biological – Protected Species: Pinnipeds (sea lions and fur seals)	Biological – Protected Species: Marine turtles (including foraging and internesting areas and significant nesting	Biological – Protected Species: Seasnakes	Biological – Protected Species: Whale sharks	Biological – Protected Species: Sharks and rays	Biological – Protected Species: Sea birds and/or migratory shorebirds	Biological – Other Species: Pelagic fish populations	Biological – Other Species: Resident /Demersal Fish	Socio-economic and Cultural: Fisheries – commercial	Socio-economic and Cultural: Fisheries – traditional	Socio-economic and Cultural: Tourism and Recreation	Socio-economic and Cultural: Protected Areas / Heritage – European and Indigenous / Shipwrecks	Socio-economic and Cultural: Offshore Oil and Gas Infrastructure (topside and subsea)	Probability of hydrocarbon contact (condensate) (%) Note: the probability is based on stochastic modelling of 300 hypothetical worst-case spills under a variety of weather and metocean conditions: Surface hydrocarbon (1–10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥50 ppb)	Accumulated hydrocarbons (>100 g/m²)
Offshore	Argo-Rowley Terrace AMP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓		2	–	–	–	–
	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		7	–	1	–	–
	Carnarvon Canyon AMP	✓	✓					✓		✓														✓	✓	✓			✓		2	–	–	–	–
	Ningaloo AMP	✓						✓		✓					✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓		63	3	20	8	–
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	100	5	67	29	–
	Shark Bay AMP/WHA	✓	✓					✓							✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		–	–	1	–	5
	Abrolhos AMP	✓	✓	✓			✓	✓		✓						✓		✓	✓	✓		✓	✓	✓	✓			✓	✓		1	–	1	–	–
Submerged shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			2	–	–	–	–
Islands	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	2	–	–	–	3
	Lowendal Islands (including State Nature Reserve)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	2	–	–	–	4
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	2	–	–	–	3

Environmental setting	Location / name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Probability of hydrocarbon contact (condensate) (%) Note: the probability is based on stochastic modelling of 300 hypothetical worst-case spills under a variety of weather and metocean conditions				
		Physical		Biological																						Socio-economic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species											
		Open water – (pristine)	*Marine Sediment – (pristine)*	*Coral reef*	*Seagrass beds / Macroalgae*	*Mangroves*	*Spawning/nursery areas*	*Open water – Productivity/upwelling*	*Non biogenic coral reefs*	*Offshore filter feeders and/or Deepwater benthic communities*	*Nearshore filter feeders*	*Sandy shores*	*Estuaries / tributaries / creeks / lagoons (including mudflats)*	*Rocky shores*	*Cetaceans – migratory whales*	*Cetaceans – dolphins and porpoises*	*Dugongs*	*Pinnipeds (sea lions and fur seals)*	*Marine turtles (including foraging and internesting areas and significant nesting*	*Seasnakes*	*Whale sharks*	*Sharks and rays*	*Sea birds and/or migratory shorebirds*	*Pelagic fish populations*	*Resident /Demersal Fish*	*Fisheries – commercial*	*Fisheries – traditional*	*Tourism and Recreation*	*Protected Areas / Heritage – European and Indigenous / Shipwrecks*	*Offshore Oil and Gas Infrastructure (topside and subsea)*	Surface hydrocarbon (1–10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥50 ppb)	Accumulated hydrocarbons (>100 g/m²)
	Muiron Islands (WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		15	–	–	–	16
	Pilbara Islands – South, Middle and Northern Island Groups	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		5	–	–	–	9
	Rowley Shoals – Clerke Reef and Imperieuse Reef State Marine Parks	✓	✓	✓			✓	✓		✓						✓			✓	✓		✓	✓	✓	✓			✓	✓		–	–	–	–	3
	Abrolhos Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓		–	–	–	–	1
Mainland (nearshore waters)	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		63	3	20	8	25
	WA coastline	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		20	1	–	–	25
	Indonesia	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		–	–	–	–	1

Summary of Potential Impacts to environmental values(s)	
Summary of Potential Impacts to protected species	
Setting	***Receptor Group***
Offshore (including Oceanic Reefs and Offshore Islands)	**Cetaceans** Marine mammals are highly mobile and a number of field and experimental observations indicate whales and dolphins may be able to detect and avoid surface slicks. However, instances have been observed where animals have swum directly into oiled areas without seeming to detect the slicks or because the slicks could not be avoided. Cetaceans may exhibit avoidance behaviour and move away from the spill-affected area. Marine mammals that have direct physical contact with surface slicks and entrained hydrocarbons may suffer surface fouling or ingestion of hydrocarbons and inhalation of toxic vapours. 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 or neurological damage (Helm et al., 2015). For example, fouling of baleen whales (e.g. humpback and pygmy blue whales) may disrupt feeding by decreasing the ability to intake prey. If prey (fish and plankton) is also hydrocarbon contaminated, this can result in the absorption of toxic components of the hydrocarbons (PAHs). Feeding appears to be rare during humpback whale migration so the potential for impacts associated with ingestion of hydrocarbons may be low for this particular species during migration. Toothed whales including dolphins, are ‘gulp-feeders’ targeting specific prey at depth in the water column away from any potential surface slick and are likely to be less susceptible to the ingestion of hydrocarbons. Furthermore, given cetaceans are smooth skinned and hydrocarbons would not tend to adhere to body surfaces, the likely biological consequences of physical contact with surface hydrocarbons is likely to be in the form of irritation and sub-lethal stress. In the event of a well blowout, there is potential that surface and entrained hydrocarbons exceeding threshold concentrations will be transported across the north and southbound migratory route (BIA) of EPBC Act listed humpback and pygmy blue whales (**Section 4.4.3**). If the well blowout occurred in July to September, it would coincide with humpback whale migration through the waters off the North West Cape (Ningaloo), Shark Bay (open ocean) and the Pilbara. If the well blowout occurred in April to August or October to January, it would coincide with pygmy blue whale migration. While opportunistic feeding may occur during migration, it is considered rare, therefore, a well blowout could result in a disruption to a portion of the population but it is not predicted to impact on the overall population viability. A loss of well containment resulting in a well blowout could result in a disruption to a portion of the humpback or pygmy blue whale populations. Such disruption could include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation) and, in rare circumstances, death. However, such disruptions or impacts are not predicted to impact on the overall population viability of cetaceans within the EMBA.
	Marine Turtles Adult sea turtles exhibit no avoidance behaviour when they encounter hydrocarbon slicks (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 gland (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). Contact with entrained hydrocarbons can 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 (Gagnon and Rawson 2010). Due to the absence of potential nesting habitat and location offshore, Operational Area 1 is unlikely to represent important habitat for marine turtles (approximately 30 km from the Muiron Islands and 38 km from the north Ningaloo Coast and water depths of approximately 400 to 600 m deep). It is however acknowledged that EMBA overlaps BIAs for several species of marine turtle (**Section 4.4.3**) in particular the internesting BIA for flatback turtles which extends around 80 km from known nesting locations.

Summary of Potential Impacts to environmental values(s)	
	In the event of a well blowout, a hydrocarbon spill may have a minor disruption to a portion of the population; however, there is no threat to overall population viability. Potential impacts to internesting marine turtles are discussed in the Mainland and Islands (nearshore) impacts discussion.
	Seasnakes 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 2011). 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; see Submerged Shoals below) and while individuals may be present in the EMBA (**Section 4.4.3**), their abundance is not expected to be high given the deepwater and offshore location of the activity. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population but there is no threat to overall population viability.
	Sharks (including Whale Sharks) and Rays Hydrocarbon contact may affect whale sharks through ingestion (entrained/dissolved hydrocarbons), particularly if feeding. Whale sharks may transit offshore open waters when migrating to and from Ningaloo Reef, where they aggregate for feeding from March to July. While not overlapping Operational Area 1, whale shark foraging BIAs lie within the EMBA in close proximity to the north and south of Operational Area 1 (**Section 4.4.3**). Therefore, individual whale sharks that have direct contact with hydrocarbons within the spill affected area may be impacted but the consequences to migratory whale shark populations are likely to be minor. 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 (consumption of prey). In the offshore environment, it is probable that pelagic shark species are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Therefore, any impact on sharks and rays is predicted to be minor and only a temporary disruption.
	Seabirds and/or Migratory Shorebirds Offshore waters are potential foraging grounds for seabirds associated with the coastal roosting and nesting habitat (Ningaloo and the Barrow/Montebello/Lowendal Island Group). There are confirmed foraging grounds off Ningaloo and the Barrow/Montebello/Lowendal Island Group and BIAs for the wedge-tailed shearwater (breeding season August–April) and the Australian fairy tern (peak use July–October) and roseate tern (mid-March to July) occur within Operational Area 1 and EMBA respectively (**Section 4.4.3**). Seabirds generally do not exhibit avoidance behaviour to floating hydrocarbons. Physical contact of seabirds with surface slicks is by several exposure pathways, primarily, immersion, ingestion and inhalation. Such contact with hydrocarbons may result in plumage fouling and hypothermia (loss of thermoregulation), decreased buoyancy and potential to drown, inability to fly or feed, anaemia, pneumonia and irritation of eyes, skin, nasal cavities and mouths (Australian Maritime Safety Authority 2013, International Petroleum Industry Environmental Conservation Association 2004) and result in mortality due to oiling of feathers or the ingestion of hydrocarbons. Longer-term exposure effects that may potentially impact seabird populations include a loss of reproductive success (loss of breeding adults) and malformation of eggs or chick (Australian Maritime Safety Authority 2013). The extent of the EMBA for a surface slick may result in impacts on feeding habitat and a disruption to a portion of the habitat however this is not expected to result in a threat to the overall population viability of seabirds or shorebirds.
Mainland and Islands (nearshore waters	**Cetaceans and Dugongs** In addition to a number of dolphin species that may occur in nearshore waters (such as spotted bottlenose dolphins, Indo-Pacific humpback dolphins and snubfin dolphins), coastal populations of small cetaceans and dugongs are known to reside or frequent nearshore waters, including the Ningaloo Coast and Shark Bay, which may be potentially impacted by surface, entrained and

Summary of Potential Impacts to environmental values(s)	
	dissolved hydrocarbons exceeding threshold concentrations in the event of a loss of well containment. The BIA for the dugong lies within the EMBA (**Section 4.4.3**). The predicted EMBA for surface hydrocarbons is located in offshore and coastal waters off the Ningaloo Coast and North West Cape, while the predicted EMBA for entrained extends from offshore and coastal waters from approximately Geraldton. The potential impacts of exposure are as discussed previously in Offshore – Cetaceans. However, 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. Nearshore dolphin species (e.g. spotted bottlenose dolphins) may exhibit higher site fidelity than oceanic species although Geraci (1988) observed relatively little impacts beyond behavioural disturbance. Additional potential environment impacts may also include the potential for dugongs to ingest hydrocarbons when feeding on oiled seagrass stands or indirect impacts to dugongs due to loss of this food source due to dieback in worse affected areas. Therefore, a hydrocarbon spill may have an impact on feeding habitats and result in a disruption to a portion of the local population but it is not predicted to result in impacts on overall population viability of either dugongs or coastal cetaceans.
	Pinnipeds Australian sea lions are found in the Houtman Abrolhos Islands Nature Reserve, which may be affected by accumulated hydrocarbons above impact thresholds (**Table 6-11**). Given the considerable distance from Operational Area 1 to these receptors, and that no surface or entrained hydrocarbons above impact thresholds were identified as potentially reaching the Abrolhos Islands, accumulated hydrocarbons at this receptor are likely to be heavily weathered and are expected to have minor or no impacts on sea lions.
	Marine Turtles Several marine turtle species utilise nearshore waters and shorelines for foraging and breeding (including internesting), with significant nesting beaches along the mainland coast and islands in potentially impacted locations such as the Ningaloo Coast. There are distinct breeding seasons as detailed in **Section 4.4.3**. The nearshore waters of these turtle habitat areas may be exposed to surface, entrained and dissolved hydrocarbons exceeding threshold concentrations, and accumulated hydrocarbons above threshold concentrations. The potential impacts of exposure are as discussed previously in Offshore – Marine Turtles. In the nearshore environment, turtles can ingest hydrocarbons when feeding (e.g. on oiled seagrass stands/macroalgae) or can be indirectly affected by loss of food source (e.g. seagrass due to dieback from hydrocarbon exposure) (Gagnon and Rawson 2010). In addition, hydrocarbon exposure can impact on turtles during the breeding season at nesting beaches. Contact with gravid adult females or hatchlings may occur on nesting beaches (accumulated hydrocarbons) or in nearshore waters (entrained hydrocarbons) where hydrocarbons are predicted to make shoreline contact. Female turtles attempting to nest may avoid oiled beaches, of become oiled externally after contacting stranded hydrocarbons (Milton et al., 2010). Note that turtles typically nest well above the high tide level, beyond the high tide level where stranded hydrocarbons typically accumulate. Oiled nesting female turtles may be subject to acute and chronic toxic effects, including reduced reproductive success and mortality (Milton et al., 2010). Hatchling turtles may encounter stranded oil when exiting the nest, and surface and entrained oil upon reaching the sea. Hatchling turtles are expected to be more vulnerable to oil exposure than adult turtles, due to the relatively smaller size and greater portion of time spend at the sea surface (i.e. more likely to encounter floating oil) (Milton et al., 2010). In the event that accumulated hydrocarbons (Ningaloo Coast only) or entrained hydrocarbons reach the shoreline or internesting coastal waters (as predicted for the Ningaloo Coast), there is the potential for impacts to turtles utilising the affected area. During the breeding season, turtle aggregations near nesting beaches in the NWMR, within the EMBA, are most vulnerable due to greater turtle densities and potential impacts may occur at the population level but it is not expected to impact on overall population viability. Several important nesting areas were identified as potentially being subject to shoreline accumulation of hydrocarbons >100 g/m^2, including Ningaloo Coast, Montebello Islands, Barrow Island and Lowendal Island (**Table 6-11**). While these are regionally significant nesting areas, all marine turtle species have significant nesting areas beyond the EMBA.
	Seasnakes As discussed previously (see 'Offshore – seasnakes') impacts to seasnakes for the mainland and island nearshore waters (including the Ningaloo Coast, and Shark Bay) from direct contact with hydrocarbons may occur but there is expected to be no threat to overall population viability.

Summary of Potential Impacts to environmental values(s)	
	Sharks (including whale sharks) and Rays Whale sharks and manta rays, known to frequent the Ningaloo Reef system (and form feeding aggregations in late summer/autumn) and transit along the Pilbara coast are vulnerable to entrained and dissolved aromatic hydrocarbon spill impacts, with both taxa having similar modes of feeding. Two BIAs in the vicinity of Operational Area 1 are associated with foraging during these annual aggregations. 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 subsurface 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 potential for individuals that are present in worse affected spill areas to ingest potentially toxic amounts of entrained/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 cause displacement of whale sharks from the area where they normally feed and rest, and potentially disrupt migration and aggregations to these areas in subsequent seasons. Whale sharks may also be affected indirectly by entrained/dissolved aromatic hydrocarbons through the contamination of their prey. If the spill event were to occur during the spawning season, this important food supply (in worse spill affected areas of the reef) may be diminished or contaminated. The contamination of their food supply and the subsequent ingestion of this prey by the whale shark may also result in long-term impacts as a result of bioaccumulation. Several threatened species of sawfish (*Pristis* spp.) may occur in coastal areas, particularly tidal creeks and estuaries. The EMBA overlaps distribution of the *Pristis* spp., including the preferred habitats of all except the Freshwater Sawfish, therefore these species may be expected to be impacted. There is the potential for other resident shark and ray populations to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat. However, it is probable that shark species will move away from the affected areas. Stochastic spill model outputs indicate potential impacts from entrained and/or dissolved aromatic hydrocarbons to the benthic communities of nearshore, subtidal communities of the Ningaloo Coast and Shark Bay it is considered that there is the potential for habitat loss to occur. Shark populations displaced or no longer supported due to habitat loss would be expected to redistribute to other locations. However, widespread habitat loss is unlikely and the consequences to resident shark and ray population (if present) are expected to be minor.
	Seabirds and/or Migratory Shorebirds In the unlikely event of a major spill, there is potential for seabirds, and resident and non-breeding overwintering shorebirds that use the nearshore waters for foraging and resting, to be exposed to surface, entrained and dissolved hydrocarbons. This could result in lethal or sub-lethal effects. Although breeding oceanic seabird species can travel long distances to forage in offshore waters, most breeding seabirds tend to forage in nearshore waters near their breeding colony, resulting in intensive feeding by higher seabird densities in these areas during the breeding season and making these areas particularly sensitive in the event of a spill. Pathways of biological exposure that can result in impact may occur through ingestion of contaminated fish (nearshore waters) or invertebrates (intertidal foraging grounds such as beaches, mudflats and reefs). Ingestion can also lead to internal injury to sensitive membranes and organs. 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. 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 at. 2012). Seabirds typically nest above the high water mark and as such, are not likely to encounter stranded hydrocarbons. As detailed in the preceding offshore setting summary, seabirds may be exposed to floating hydrocarbons, resulting in lethal and sub-lethal impacts. Important areas for foraging seabirds and migratory shorebirds are identified in **Section 4.4.3**. Refer to **Table 6-11** for locations within the predicted extent of the EMBA that are identified as habitat for seabirds/migratory shorebirds. Suitable habitat or seabirds and shorebirds are broadly distributed

Summary of Potential Impacts to environmental values(s)

along the mainland and nearshore island coasts within the EMBA. Of note are important nesting and resting areas, including (refer to **Section 4.4.3** for additional information):

- Ningaloo Coast
- North West Cape
- Shark Bay
- Abrolhos Islands.

A hydrocarbon spill may result in sub-lethal or lethal impacts to seabirds in the event that entrained hydrocarbons overlap foraging areas and result in the contamination of prey species. Migratory birds/shorebirds may also be affected, with entrained hydrocarbons potentially affecting birds through impacts to prey species.

Protected Species Populations (all settings)

Based on the modelling approach outlined in **Section 6.6.2.1**, the environmental sensitivities listed in **Table 6-12** were identified as potentially being affected by the greatest area of shoreline accumulation. Potential population-scale impacts for the fauna groups in **Table 6-12** are considered below.

Table 6-12: Key receptor locations and sensitivities for a 77-day loss of well containment of Enfield crude, as determined by the greatest area of shoreline accumulation above impact thresholds

Location	***Cetaceans – migratory whales***	***Cetaceans – dolphins and porpoises***	***Dugongs***	***Pinnipeds***	***Turtles***	***Seasnakes***	***Whale sharks***	***Sharks and rays***	***Birds***
Muiron Islands	✓	✓	✓		✓	✓	✓	✓	✓
Ningaloo Coast (north, middle and south)	✓	✓	✓		✓	✓	✓	✓	✓
Shark Bay	✓	✓	✓		✓	✓		✓	✓
Abrolhos Islands	✓	✓		✓	✓	✓		✓	✓

Cetaceans – Migratory Whales

Humpback and blue whales migrate seasonally through the EMBA, and may be impacted by exposure to spilled hydrocarbons from a worst-case loss of well containment as described in the preceding section (Offshore (including Oceanic Reefs and Offshore Islands)). Such exposure may result in a range of sub-lethal and lethal impacts, depending on the nature of hydrocarbon exposure. Baleen whales are considered relatively resistant to spilled oil compared to other marine mammals (e.g. pinnipeds, sea otters etc.) (Geraci and Aubin, 1988).

The humpback whale population off Western Australia has exhibited considerable recovery following the significant decline due to commercial whaling, with the rate of increase in the order of 10% per annum (Salgado-Kent et al., 2012). The migration of humpback whales along the Western Australian coastline is protracted, and the entire population will not credibly be within the area affected by spilled hydrocarbons from a worst-case loss of well containment. Migration patterns of blue whales are similar (although further offshore), in that the distribution of migrating animals is protracted (Double et al., 2014), and the entire population will not occur within the area affected by a worst-case hydrocarbon spill.

The portion of the humpback and blue whale populations exposed to spilled hydrocarbons from a worst-case loss of well containment would not experience total mortality; impacts to animals exposed to hydrocarbons above impact thresholds are expected to largely be sub-lethal. Population scale impacts to humpback and blue whales in the event of a worst-case loss of well containment are not expected to occur based on:

- a portion of each population can credibly be exposed to spilled hydrocarbons
- potential impacts to the exposed portion of the population are expected to largely be sub-lethal
- blue whale and humpback whale populations have shown considerable recovery potential.

Summary of Potential Impacts to environmental values(s)	
	Cetaceans – Dolphins and Porpoises Populations of coastal dolphins and porpoises may be affected by a worst-case loss of well containment, although oceanic species (e.g. spinner dolphins) will not experience population-scale impacts due to their widespread distribution. Coastal dolphin species with resident populations include bottlenose dolphins and Indo-Pacific humpback dolphins within the areas identified by the worst-case modelling. Indo-Pacific humpback dolphins may have localised populations with relatively little exchange between populations (Brown et al., 2014, 2016; Parra and Cagnazzi 2016). The distribution of this species lies largely to the north of EMBA, although there is a resident population in coastal waters around North West Cape (Brown et al., 2014). Given the nature of impacts to dolphins exposed to hydrocarbons are expected to be largely sub-lethal, the potential for population scale impacts to the resident Indo-Pacific humpback dolphins at North West Cape is considered to be unlikely. It is expected that this population would recover over time through local recruitment and migration of individuals (although Woodside acknowledges that genetic studies indicates relatively little gene flow between populations discrete populations along the Western Australian coastline). This is consistent with the decline and recovery of coastal cetacean populations within the area affected by oil spills during the Gulf War (Preen 2004), which were significantly larger than the worst-case credible spill considered in this EP. Bottlenose dolphins show site fidelity, although studied populations do show transient movements of individuals between populations and genetic exchange at relatively large spatial scales (hundreds of kilometres) (Fury and Harrison, 2008; Krützen et al., 2004). As such, no population-scale impacts to bottlenose dolphins are expected to occur, as any population within an affected area is expected to recover through an influx of animals and natural recruitment. **Dugongs** Potential impacts to dugongs from exposure to spilled hydrocarbons are described above in Mainland and Islands (nearshore waters). Dugongs are broadly (although often sparsely) distributed in coastal waters, with relatively high densities in coastal embayments such as Exmouth Gulf and Shark Bay. Stochastic modelling results indicated little potential for spilled hydrocarbons to impact directly upon Exmouth Gulf and Shark Bay, both of which host significant dugong populations. Tagging studies of dugongs have indicated individual animals undertake long distance movements (Gales et al., 2004; Sheppard et al., 2006). Additionally, there is evidence of considerable genetic exchange between populations within Australia, and between populations in Australia and south-east Asia (McDonald 2005). This suggests that dugong populations cover a considerable spatial extent, and that a worst-case hydrocarbon spill from a loss of well containment would affect only a small portion of the dugong population off Western Australia. Dugong populations exposed to large-scale oil spills have been shown to be resilient, with no significant decrease in population size (Preen 2004). When considering this resilience and the species' widespread population, the potential for population-scale impacts in the event of a worst-case loss of well containment is considered to be low. **Pinnipeds** The only significant pinniped population within the EMBA is the Australian sea lion population at the Abrolhos Islands. Given the distance of this population from the release location, any spilled hydrocarbons from a worst-case loss of well containment are expected to be highly weathered prior to reaching this population. Lethal impacts resulting from acute toxicity or hypothermia due to smothering are not expected to occur. No impacts to pinnipeds at a population scale are expected to occur in the event of a worst-case loss of well containment. **Turtles** Several species of turtle were identified as potentially occurring within the EMBA (**Section 4.4.3**). The distributions of each of these species extends beyond the EMBA, although significant habitats, including nesting beach (discussed below) do occur within the EMBA. The worst-case loss of well containment modelling results indicated that a number of known turtle nesting beaches may be contacted by accumulated hydrocarbons, including the Ningaloo Coast, Muiron Islands and Shark Bay. These areas are known to host nesting beaches for green, loggerhead and flatback turtles (**Section 4.4.3**). The behaviour and biology of marine turtles makes these species relatively vulnerable to population-scale impacts compared to other fauna, such as dugongs. All species of marine turtles exhibit high nesting site fidelity by females, with gene flow between populations primarily mediated by movements of male turtles (FitzSimmons et al., 1997). Additionally, marine turtles rely on nesting beaches to reproduce, which makes them vulnerable to impacts from spilled hydrocarbon accumulations on shorelines through oiling of nesting females and emergent hatchlings, disturbance of nests from spill

	response activities (Lauritsen et al., 2017). A spill during nesting and hatching season poses an increased to marine turtle populations. Results from studies of nesting beaches subject to extensive oil pollution from the Deepwater Horizon spill indicated a significant reduction (approximately 44%) in turtle nest density during the nesting season immediately following the spill (Lauritsen et al., 2017). Lauritsen et al. (2017) partially attributed this reduction to direct (e.g. direct mortality of adults due to oiling or toxicity) and indirect (e.g. shoreline disturbance from response activities) impacts from the spill. A significant increase in nesting density in the years immediately following the spill; nesting density returning to levels comparable to pre-spill densities within two nesting seasons (Lauritsen et al., 2017). This indicates that adult female turtles that avoided mortality may have deferred nesting during the spill until subsequent years. The significant decline in nesting density observed following the Deepwater Horizon spill represents a decline of approximately 36% of reproductive output of the turtle population in the study area (Lauritsen et al., 2017); given turtles may take over a decade to reach sexual maturity, the effects of such a reduction in reproductive output may take over a decade to appear in nesting-related metrics (which are commonly used to monitor turtle populations). Based on the modelling results and the potential for impact and recovery of turtles, a worst-case hydrocarbon spill from a loss of well containment may result in reductions in turtle numbers and nesting density, however, it would not be expected to result in elimination of a population. Impacts and subsequent recovery may take decades to occur. To date, no oil spills have been demonstrated to have resulted in elimination of a turtle population at any scale (Yender and Mearns 2010). Disastrous spills impacting important turtle habitat (including nesting areas) have not been shown to eliminate turtle populations, although direct and indirect impacts have been documented (e.g. Lauritsen et al., 2017; McDonald et al., 2017; Stacy et al., 2017; Vander Zanden et al., 2016). Turtle populations have been shown to be able to recover, even when populations have been reduced to small sizes after experiencing significant declines (Mazaris et al., 2017). As such, population scale impacts to marine turtles from a worst-case loss of well containment would be expected to exhibit recovery, although may take several decades to reach pre-impact population levels due to the relatively long lifespan and late sexual maturity of marine turtle species. **Seasnakes** Seasnake species in the area, identified by the worst-case modelling, are widely distributed, with considerable genetic exchange between populations (Lukoschek et al., 2008). Connectivity of suitable seasnake habitat (i.e. shallow coastal waters) exists between the areas identified by the worst-case modelling and unaffected areas, facilitating movement of individuals into affected areas following recovery. As such, population scale impacts to seasnakes are not expected to occur in the event of a worst-case loss of well containment. **Whale Sharks** Modelling of a worst-case loss of well containment indicated the potential for hydrocarbons above impact thresholds off the Ningaloo Coast, which hosts annual aggregations of whale sharks (**Section 4.4.3**). Studies of whale sharks aggregating at Ningaloo have shown individuals returning to the area over multiple years, with Meekan et al. (2006) suggesting these animals form a population of approximately 300 to 500 individuals. Inter-annual resighting typically occurred over a timeframe of 1–3 years, although resighting after a period of 12 years was recorded for one individual (Meekan et al., 2006). This suggests a worst-case loss of well containment during the seasonal aggregation would not affect all whale sharks known to aggregate off Ningaloo, as a portion of these animals would be absent at any particular time. Population genetics studies of whale sharks indicate relatively little differentiation between populations, indicating gene flow within and between populations at an ocean basin scale (Castro et al., 2007, Schmidt et al., 2009). As such, population scale impacts to whale sharks are not expected to occur in the event of a worst-case loss of well containment. **Sharks and Rays** Migratory oceanic shark species (excluding whale sharks, refer to discussion above) have wide distributions and are not considered to be particularly susceptible to a hydrocarbon spill from a worst-case loss of well containment. Inshore shark species such as sawfish are more vulnerable to population scale impacts due to their life history and spatial restriction of preferred habitats (Commonwealth of Australia 2015); however, worst-case modelling did not indicate impacts to critical sawfish habitat such as estuaries. **Birds** Seabird species with resident populations in the area potentially affected by a worst-case loss of well containment have broad distributions. Potential impacts such as mortality or reduced reproductive output may result in minor impacts to local populations. Migratory shorebirds are seasonally present in the area potentially affected (as determined by the worst-case scenario). However, entire populations of migratory species will not occur within the area potentially impacted, and hence, there is no potential for a worst-case loss of well containment. Studies of migratory bird populations impacted by the Deepwater Horizon spill indicated direct sub-

Summary of Potential Impacts to environmental values(s)	
	lethal impacts to approximately 8.6% of individuals, and little evidence of direct mortality (Henkel et al., 2012). Potential impacts from a worst-case loss of well containment are expected to be consistent with these results, and population scale impacts to migratory birds are not expected to occur.
Summary of potential impacts to marine primary producers	
Setting	***Receptor Group***
Mainland and Islands (nearshore waters)	**Coral Reef** The quantitative spill risk assessment and output EMBA indicate there would be potential for entrained and dissolved aromatic hydrocarbons (above threshold concentration) to contact shallow nearshore waters and therefore exposure of subtidal corals associated with the fringing reefs located at a number of mainland and island locations. Areas that may be contacted by entrained hydrocarbons and dissolved hydrocarbons include the Ningaloo Coast. There is the potential for reefs along the Ningaloo Coast to be exposed to entrained and/or dissolved aromatic hydrocarbons concentrations that are considered to induce toxicity effects, particularly for reproductive and juvenile stages of invertebrate and fish species. Shoreline accumulation above impact thresholds may occur at the Rowley Shoals (Clerke and Imperieuse Reef), which host intertidal and shallow subtidal corals. Exposure to entrained hydrocarbons/dissolved aromatic hydrocarbons 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 mainland coast (e.g. Ningaloo Coast). In the unlikely event of a spill occurring at the time of coral spawning at potentially affected coral locations or in the general peak period of biological productivity, there is potential for a significant reduction in successful 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. Over the worst affected sections of reef habitat, coral community live cover, structure and composition is predicted to reduce, manifested by loss of corals and associated sessile biota. Recovery of these impacted reef areas relies on coral larvae from neighbouring coral communities that have either not been affected or only partially impacted. For example, there is evidence that Ningaloo Reef corals and fish are partly self-seeding (Underwood 2009) with the supply of larvae from locations within Ningaloo Reef of critical importance to the healthy maintenance of the coral communities. Therefore, a hydrocarbon spill may result in large-scale impacts to coral reefs, with long-term effects (recovery >10 years) likely.
	Seagrass Beds / Macroalgae and Mangroves Spill modelling has predicted entrained hydrocarbons and dissolved aromatic hydrocarbons, have the potential to contact a number of shoreline sensitive receptors such as those supporting biologically diverse, shallow subtidal and intertidal communities. The variety of habitat and communities types, from the upper subtidal to the intertidal zones support a high diversity of marine life and are utilised as important foraging and nursery grounds by a range of invertebrate and vertebrate species. Seagrass and macroalgal beds occurring in the intertidal and subtidal zone may be susceptible to impacts from entrained/dissolved hydrocarbons. Toxicity effects can also occur due to absorption of soluble fractions of hydrocarbons into tissues (Runcie et al., 2010). The potential for toxicity effects of entrained hydrocarbons may be reduced by weathering processes that should serve to lower the content of soluble aromatic components before contact occurs. Exposure to entrained/dissolved aromatic hydrocarbons may result in mortality, depending on actual entrained/dissolved aromatic hydrocarbon concentration received and duration of exposure. Physical contact with entrained hydrocarbon droplets could cause sub-lethal stress, causing reduced growth rates and a reduction in

Summary of Potential Impacts to environmental values(s)	
	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. Depending on the trajectory of the entrained and dissolved hydrocarbon plume, macroalgal/seagrass communities at the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms); refer to **Table 6-11** for a list of identified seagrass/macroalgae receptors, that may be exposed. Mangrove habitat and associated mud flats and salt marsh at Ningaloo Coast (small habitat areas), have the potential to be exposed (See **Table 6-11** for the full list of receptors). Hydrocarbons coating prop roots of mangroves can occur from surface hydrocarbons when 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 aromatic hydrocarbons that may adhere to the sediment particles. In low energy environments such as in mangroves, deposited sediment-bound hydrocarbons are unlikely to be removed naturally by wave action and may be deposited in layers by successive tides (National Oceanic and Atmospheric Administration 2014). 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 directly impacted due to the loss of habitats and/or lethal and sub-lethal in-water toxic effects. This may result in mortality or impairment of growth, survival and reproduction (Heintz et al., 2000). In addition, there is the potential for secondary impacts on shorebirds, fish, sea turtles, rays, and crustaceans that utilise these intertidal habitat areas for breeding, feeding and nursery habitat purposes.
Summary of potential impacts to other habitats and communities	
Setting	***Receptor Group***
Offshore	**Benthic Fauna Communities** Benthic infauna communities in the vicinity of the well may be impacted resulting in changes to community structure. Furthermore, the low sensitivity benthic communities associated with the unconsolidated, soft sediment habitat and any epifauna (filter feeders) associated with the consolidated sediment habitat/limestone ridge habitat (e.g. the Ancient Coastline KEF, approximately 19 km away) within and outside Operational Area 1 are not expected to have widespread exposure to released hydrocarbons. A localised area relating to the hydrocarbon plume at the point of release is predicted, which would result in a small area of seabed and associated epifauna and infauna exposed to hydrocarbons. Evidence from the Deepwater Horizon spill in the Gulf of Mexico recorded low taxa richness and high nematode/harpacticoid-copepod ratios within 3 km of the release location and moderate impacts up to 17 km away (Montagna et al., 2013). The communities were likely exposed to dispersed hydrocarbons as the response included subsea dispersant application. A loss in benthic biodiversity has been correlated to a decline in deep-water ecosystem functioning (Danovaro et al., 2008). The location of the petroleum activity and the EMBA largely affect continental shelf waters, which are shallower than the Deepwater Horizon spill and as such may host more diverse infauna communities although the impacts are considered to be similar. Therefore, a loss of well containment may result in localised but long-term effects on community structure. **Demersal Fish** The continental slope demersal fish communities KEF in the region have been identified as a key ecological feature, and occurs within Operational Area 1. Additionally, demersal species have also been observed within the Enfield Canyon (also within Operational Area 1), associated with the occurrence of isolated boulders. Mortality and sub-lethal effects may impact populations located close to the loss of well containment and within the EMBA for entrained/dissolved aromatic hydrocarbons. Additionally, if prey (infauna and epifauna) surrounding the well location and within the EMBA is contaminated, this can result in the absorption of toxic components of the hydrocarbons (PAHs) potentially impacting fish populations that feed on these. These impacts may result in localised medium/long-term impacts on demersal fish habitat, e.g. seafloor.
	Open Water – Productivity/Upwelling Primary production by plankton (triggered by sporadic upwelling events in the offshore waters of the Northwest Province) is an important component of the primary marine food web. Planktonic communities are generally mixed including phytoplankton (cyanobacteria and other microalgae) and secondary consuming zooplankton (crustaceans (e.g. copepods), and the eggs and larvae of fish and

Summary of Potential Impacts to environmental values(s)	
	invertebrates (meroplankton). 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 suffocation, changes in behaviour, or environmental changes that make them more susceptible to predation. Impacts on plankton communities are likely to occur in areas where surface, entrained or dissolved aromatic hydrocarbon threshold concentrations are exceeded, but communities are expected to recover relatively quickly (within weeks or months). This is due to high population turnover with copious production within short generation times that also buffers the potential for long-term (i.e. years) population declines (International Tanker Owners Pollution Federation, 2011). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and temporary.
	Open Water – Physical Displacement of Fauna from Gas Plume The effect of the physical extent of the gas plume in the environment is expected to have a limited and localised effect on identified receptors such as the physical barrier created by the gas plume, which may cause the displacement of transient and/or mobile biota such as pelagic fish, megafauna species (migratory whales) and plankton. It is acknowledged that the physical extent of the plume may displace some open water species transiting the offshore waters of this area of the NWS. The extent of the plume is relatively small in comparison to the surrounding offshore environment but the overall impact to the in-water biota and the marine environment in general is expected to be slight to minor short-term impact to communities present in the EMBA.
Mainland and Islands (Nearshore Waters)	**Open Water – Productivity/Upwelling** Nearshore waters and adjacent offshore waters surrounding the offshore islands (e.g. Barrow and Montebello Islands) and to the west of the Ningaloo reef system are known locations of seasonal upwelling events and productivity. The seasonal productivity events are critical to krill production, which supports megafauna aggregations such as whale sharks and manta rays in the region. This has the potential to result in lethal and sub-lethal impacts to a certain portion of plankton in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. However, recovery would occur (see offshore description above). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and temporary in nature.
	Spawning/Nursery Areas Fish (and other commercially targeted taxa) in their early life stages (eggs, larvae and juveniles) are at their most vulnerable to lethal and sub-lethal impacts from exposure to hydrocarbons, particularly if a spill coincides with spawning seasons or if a spill reaches nursery areas close to the shore (e.g. seagrass and mangroves) (International Tanker Owners Pollution Federation 2011). Fish spawning (including for commercially targeted species such as snapper and mackerel) occurs in nearshore waters at certain times of the year and nearshore waters are also inhabited by higher numbers of juvenile fishes than offshore waters. Modelling indicated that in the unlikely event of a major spill there is potential for entrained hydrocarbons to occur in the surface water layers above threshold concentrations in nearshore waters including, but not limited to the Ningaloo Coast and Shark Bay. This, and the potential for possible lower concentration exposure for dissolved aromatic hydrocarbons, have the potential to result in lethal and sub-lethal impacts to a certain portion of fish larvae in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. Although there is the potential for spawning/nursery habitat to be impacted (e.g. mangroves and seagrass beds, discussed above), losses of fish larvae in worst affected areas are unlikely to be of major consequence to fish stocks compared with significantly larger losses through natural predation, and the likelihood that most nearshore areas would be exposed is low (i.e. not all areas in the region would be affected). This is supported by a recent study in the Gulf of Mexico which used juvenile abundance data, from shallow-water seagrass meadows, as indices of the acute, population-level responses of young fishes to the Deepwater Horizon spill. Results indicated that there was no change to the juvenile cohorts following this spill. Additionally there were no significant post-spill shifts in community composition and structure, nor were there changes in biodiversity measures (Fodrie and Heck, 2011). Any impacts to spawning and nursery areas are expected to be minor and short term, as would flow on effects to adult fish stocks into which larvae are recruited.
	Non Biogenic Coral Reefs The coral communities fringing the offshore Ningaloo Coast region may be exposed to entrained hydrocarbons and consequently exhibit lethal or sub-lethal impacts resulting in partial or total mortality of keystone sessile benthos, particularly, hard corals and thus potential community structural changes to these shallow, nearshore benthic communities may occur. In the event that these reefs are exposed to entrained hydrocarbons, impacts are expected to result in localised long-term effects.

<table>
<tr><th colspan="2">Summary of Potential Impacts to environmental values(s)</th></tr>
<tr><td></td><td>Filter Feeders
Hydrocarbon exposure to offshore, filter-feeding communities (e.g. deepwater communities of Ningaloo coast in 20–200 m) may occur depending on the depth of the entrained and dissolved aromatic hydrocarbons. See discussion above on potential impacts.</td></tr>
<tr><td></td><td>Sandy Shores/Estuaries/Tributaries/Creeks (Including Mudflats)/Rocky Shores
Shoreline exposure for the upper and lower areas differ, the upper shore has the potential to be exposed to surface slicks, while the lower shore is subjected to dissolved or entrained hydrocarbon.
Potential impacts may occur due to surface hydrocarbon contact with intertidal areas, including sandy shores, mudflats and rocky shores, listed in Table 6-11. Hydrocarbon at sandy shores is incorporated into fine sediments through mixing in the surface layers from wave energy, penetration down worm burrows and root pores (International Tanker Owners Pollution Federation [ITOPF], 2011). Hydrocarbon in the intertidal zone can adhere to sand particles however high tide may remove some or most of the hydrocarbon back of the sediments. Typically hydrocarbon is only incorporated into the surface layers to a maximum of 10 cm. As described earlier, accumulated hydrocarbons ≥ 100 g/m^2 could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat (French-McCay 2009). The persistent of the hydrocarbon will be dependent on the wave exposure but can be months to years. It is predicted that a number of sandy shores along the WA coast and islands in the EMBA may have accumulation of hydrocarbons ≥ 100 g/m^2 as shown in Figure 4-1.
The impact of hydrocarbon on rocky shores will be largely dependent on the incline and energy environment. On steep/vertical rock faces on wave exposed coasts there is likely to be no impact from a spill event. However, a gradually sloping boulder shore in calm water can potentially trap large amounts of hydrocarbon (International Petroleum Industry Environmental Conservation Association [IPIECA], 2000). The impact of the spill on marine organisms along the rocky coast will be dependent on the toxicity and weathering of the hydrocarbon. Similar to sandy shores accumulated hydrocarbons ≥ 100 g/m^2 could coat the epifauna along rocky coasts and impact the reproductive capacity and survival. There is potential for impact to rocky shores such as along Barrow Island, Montebello Islands, Lowendal Islands and the Muiron Islands.
Intertidal mudflats are susceptible to potential impacts from hydrocarbons as they are typically low energy environments and therefore trap hydrocarbons. The extent of oiling is influenced by the neap and spring tidal cycle and seasonal highs and lows affecting mean sea level. Potential impacts to tidal flats include heavy accumulations covering the flat at low tide however it is unlikely that hydrocarbon will penetrate the water-saturated sediments. However, hydrocarbon can penetrate sediments through animal burrows and root pores. It has been demonstrated that infaunal burrows allow hydrocarbons to subsurface sediments where it can be retained for months.
Potential impacts may occur due to entrained contact with shallow, subtidal and intertidal zones of the Ningaloo Coast, and shoreline accumulation at Barrow Island, Montebello Islands and the Muiron Islands. In-water toxicity of the entrained hydrocarbons reaching these shores will determine impacts to the marine biota such as sessile barnacle species and/or mobile gastropods and crustaceans such as amphipods. Lethal and sub-lethal impacts may be expected where the entrained hydrocarbon concentration threshold is >100 ppb. Impacts may result in localised changes to the community structure of these shoreline habitats which would be expected to recover in the medium term (2–5 years).</td></tr>
<tr><td>Key Ecological Features</td><td>Key Ecological Features
Potentially impacted by the hydrocarbon spill from a loss of well containment event are:
Canyons that link the Cuvier Abyssal Plan with the Cape Range Peninsula
Continental slope demersal fish communities
Ancient coastline at 125 m depth contour
Commonwealth waters adjacent to Ningaloo Reef
Exmouth Plateau
Glomar Shoals
Western demersal slope and associated fish communities
Wallaby Saddle
Mermaid reef and commonwealth waters surrounding Rowley Shoals
Ancient coastline at 90–120 m depth
Western rock lobster
Commonwealth marine environment within and adjacent to the west coast inshore lagoons</td></tr>
</table>

Summary of Potential Impacts to environmental values(s)	
	• Commonwealth marine environment surrounding the Houtman Abrolhos Islands • Perth Canyon and adjacent shelf break, and other west coast canyons. Although these KEFs are primarily defined by seabed geomorphological features, they are described to identify the potential for increased biological productivity and, therefore, ecological significance. The consequences of a hydrocarbon spill from a loss of well containment may impact the values of the KEFs affected (for the values of each KEF see **Section 4.6.7**). Potential impacts include: the contamination of sediments, impacts to benthic sediment fauna and associated impacts to demersal fish populations and reduced biodiversity as described above and below. Most of the KEFs within the EMBA have relatively broad-scale distributions and are unlikely to be significantly impacted.
Summary of potential impacts to water quality	
Setting	***Aspect***
Offshore	**Open Water – Water Quality** Water quality would be affected due to hydrocarbon contamination which is described in terms of the biological effect concentrations. These are defined by the EMBA descriptions for each of, entrained and dissolved hydrocarbon fates and their predicted extent (refer to **Table 6-11**). Furthermore, water quality is predicted to have minor long-term and/or significant short-term hydrocarbon contamination above background and/or national/international quality standards.
Mainland and Islands (Nearshore waters)	**Open Water – Water Quality** Water quality would be affected/reduced due to hydrocarbon contamination, with modelling predictions indicating that hydrocarbon contact is at or above biological effect concentrations for entrained and dissolved hydrocarbons in nearshore waters of identified islands and the mainland coast (refer to **Table 6-11**). Such reduction in water quality is predicted to have minor long-term or significant short-term hydrocarbon contamination above background and/or national/international quality standards.
Summary of potential impacts to marine sediment quality	
Setting	***Receptor Group***
Offshore	**Marine Sediment Quality** Studies of hydrocarbon concentrations in deep sea sediments in the vicinity of a catastrophic well blowout indicated hydrocarbon from the blowouts can be incorporated into deep ocean 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 crude 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.
Mainland and Islands (Nearshore waters)	**Marine Sediment Quality** Entrained hydrocarbons (at or above the defined thresholds) are predicted to potentially contact shallow, nearshore waters of identified islands and mainland coastlines and hydrocarbons may accumulate (at or above the ecological threshold) at the Ningaloo Coast and WHA, Shark Bay WHA, Muiron Islands, Barrow Island, Lowendal Islands, Pilbara Islands, Abrolhos Islands and the Montebello Islands (refer to **Table 6-11**). Such hydrocarbon contact may lead to reduced marine sediment quality by several processes, such as adherence to sediment and deposition shores or seabed habitat.

<table>
<tr><th colspan="2">Summary of Potential Impacts to environmental values(s)</th></tr>
<tr><th colspan="2">Summary of potential impacts to air quality</th></tr>
<tr><td colspan="2">A hydrocarbon release during a loss of well containment has the potential to result in localised, temporary reduction in air quality. Potential impacts are expected to be a slight and temporary localised effect to ecosystems, species and/or habitats in the area.
There is potential for human health effects for workers in the immediate vicinity of atmospheric emissions. The ambient concentrations of methane and VOCs released from diffuse sources is difficult to accurately quantify, although their behaviour and fate is predictable in open offshore environments as it is dispersed rapidly by meteorological factors such as wind and temperature. Methane and VOC emissions from a hydrocarbon release in such environments are rapidly degraded in the atmosphere by reaction with photo chemically-produced hydroxyl radicals.
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 Operational Area 1 to the nearest sensitive air shed (town of Exmouth approximately 47 km away), the potential impacts are expected to be minor and temporary.</td></tr>
<tr><th colspan="2">Summary of potential impacts to protected areas</th></tr>
<tr><td colspan="2">The quantitative spill risk assessment results indicate that the open water environment protected within the Australian Marine Parks listed in refer to Table 6-11 may be affected by the released hydrocarbons. In the unlikely event of a major spill and entrained hydrocarbons and/or dissolved hydrocarbons may contact the identified key receptor locations of islands and mainland coastlines resulting in the actual or perceived contamination of protected areas as identified for the EMBA (refer to Table 6-11).
Many of the protected areas identified contain marine fauna and biological communities, which are considered to be of important environmental value that the protected areas are intended to protect (Section 4.6). As outlined in the preceding table sections, a worst-case loss of well containment may impact upon a range of these values simultaneously, and different receptors in an affected area may recover at different rates. In the event of simultaneous impacts to environmental values within a protected area, the collective environment of the protected area may be compromised to a greater extent than the assessments of each individual value would indicate.
Impact on the protected areas is discussed in the sections above for ecological the values and sensitivities and below for socio-economic values. Additionally, such hydrocarbon contact may alter stakeholder understanding and/or perception of the protected marine environment, given these represent areas largely unaffected by anthropogenic influences and contain biological diverse environments.</td></tr>
<tr><th colspan="2">Summary of potential impacts to socio-economic values</th></tr>
<tr><th>Setting</th><th>Receptor Group</th></tr>
<tr><td>Offshore</td><td>Fisheries – Commercial
Spill scenarios modelled are unlikely to cause significant direct impacts on the target species of Commonwealth and offshore State fisheries within the defined EMBA. Further details are provided below (impact assessment relating to spawning is discusses above under ‘Summary of potential impacts to other habitats and communities’).
Commonwealth fisheries: The predicted EMBA resulting from a major spill may impact on the area fished by a number of Commonwealth fisheries including tune fisheries: Western Tuna and Billfish, Southern Bluefin Tuna, Western Skipjack Fishery (for which limited fishing activity has occurred in this area in recent years) and the North West Slope Trawl and Western Deepwater Trawl target pelagic fish species (refer to Section 4.5.3). Adult fish are highly mobile and able to move away from the spill affected area or avoid the surface waters; however, hydrocarbon concentrations in the upper water column could lead to potential exposure through direct absorption of hydrocarbons and indirectly by the consumption of contaminated prey. Given these pelagic species are distributed over a wide geographical area, the impacts at the population or species level are considered minor in the unlikely event of a spill.
State Fisheries: The predicted EMBA resulting from a major spill may impact on the area fished by a number of State fisheries (refer to Section 4.5.3). These fisheries generally use a range of gear types (trawl, trap and line) and operate from shallow inshore water to water depths up to 200 m, targeting demersal and pelagic finfish species and prawns. In the unlikely event of a major hydrocarbon spill, there is the potential for the targeted fish species to be exposed to entrained and/or dissolved aromatic hydrocarbons in the water column. However, the potential for direct impact would be reduced as target species such as mackerel and snapper are likely to avoid the surface water layer underneath oil slicks. Demersal species (such as finfish and crustaceans) have limited mobility and therefore, will not be able to easily move away from a spill. Mortality/sub-lethal effects may impact populations</td></tr>
</table>

Summary of Potential Impacts to environmental values(s)	
	located close to the well blowout location. A major loss of hydrocarbons from the Petroleum Activities Program may lead to an exclusion of fishing from the spill affected area for an extended period. A number of other State and Commonwealth fisheries, further afield in the EMBA (refer to **Section 4.5.3**), may also be affected by a major spill, however, the impacts to these far field fisheries will be similar to that described below for 'General Fisheries Impacts'. *General Fisheries Impacts:* Fish exposure to hydrocarbon can result in 'tainting' of their tissues. Even very low levels of hydrocarbons can impart a taint or 'off' flavour or smell in seafood. Tainting is reversible through the process of depuration which removes hydrocarbons from tissues by metabolic processes, although it is dependent upon the magnitude of the hydrocarbon contamination. Fish have a high capacity to metabolise these hydrocarbons while crustaceans (such as prawns) have a reduced ability (Yender et al., 2002). Seafood safety is a major concern associated with spill incidents. Therefore, actual or potential contamination of seafood can affect commercial and recreational fishing, and can impact seafood markets long after any actual risk to seafood from a spill has subsided (Yender et al., 2002). A major spill would result in the establishment of an exclusion zone around the spill affected area. There would be a temporary prohibition on fishing activities for a period of time and subsequent potential for economic impacts to affected commercial fishing operators.
	Tourism including Recreational Activities 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 Operational Area 1. Impacts on species that are recreationally fished are described above and under 'Summary of potential impacts to other species' above. A major loss of hydrocarbon from the Petroleum Activities Program may lead to exclusion of marine nature-based tourist activities, resulting in a loss of revenue for operators.
	Offshore Oil and Gas Infrastructure In the unlikely event of a major spill, surface hydrocarbons may affect production from existing petroleum facilities (platforms and 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 offtake tankers approaching facilities off the North West Cape. The impact on ongoing operations of regional production facilities would be determined by the nature and scale of the spill and metocean conditions. Furthermore, decisions on the operation of production facilities in the event of a spill would be based primarily on health and safety considerations. The closest production is the Ngujima Yin FPSO (operated by Woodside). Other nearby facilities include the Santos operated Ningaloo Vision FPSO and the BHP operated Pyrenees Venture FPSO. Operation of these facilities is likely to be affected in the event of a well blow-out spill.
Mainland and Islands (Nearshore Waters)	**Fisheries – Commercial** *Nearshore Fisheries and Aquaculture:* In the unlikely event of a loss of well containment, there is the possibility that target species in some areas utilised by a number of state fisheries in nearshore waters of the Ningaloo Coast and Shark Bay, and aquarium fisheries in the nearshore waters that are within the EMBA could be affected. Targeted fish resources could experience sub-lethal stress, or in some instances, mortality depending on the concentration and duration of hydrocarbon exposure and its inherent toxicity. *Prawn Managed Fisheries:* In the event of a major spill, the modelling indicated the entrained EMBA may extend to nearshore waters closest to the mainland coasts, including the actively fished areas of the designated Shark Bay Prawn and Scallop Managed Fishery. Prawn habitat utilisation differs between species in the post-larval, juvenile and adult stages (Dall et al., 1990) and direct impacts to benthic habitat due to a major spill has the potential to impact prawn stocks. For example, juvenile banana prawns are found almost exclusively in mangrove-lined creeks, whereas juvenile tiger prawns are most abundant in areas of seagrass (Masel and Smallwood 2000). Adult prawns also inhabit coastline areas but tend to move to deeper waters to spawn. In the event of a major spill, the model predicted shallow subtidal and intertidal habitats at the Ningaloo Coast, and mangrove and seagrass habitats of the Ningaloo Coast are located within the EMBA and could be exposed to hydrocarbon concentrations above threshold concentrations, depending on the trajectory of the plume. Localised loss of juvenile prawns in worse spill affected areas is possible. Whether lethal or sub-lethal effects occur will depend on duration of exposure, hydrocarbon concentration and weathering stage of the hydrocarbon and its inherent toxicity. Furthermore, seafood consumption safety concerns and a temporary prohibition on fishing activities may lead to subsequent potential for economic impacts to affected commercial fishing operators.

Summary of Potential Impacts to environmental values(s)	
	Fisheries – traditional Although no designated traditional fisheries have been identified it is recognised that indigenous communities fish in the shallow coastal and nearshore waters of Ningaloo Reef, and therefore, may be potentially impacted if a hydrocarbon spill from a loss of well containment were to occur. Impacts would be similar to those identified for commercial fishing in the form of a potential exclusion zone and contamination/tainting of fish stocks.
	Tourism and recreation In the unlikely event of a major spill, the nearshore waters of the Ningaloo Coast could be reached by entrained hydrocarbon, depending on prevailing wind and current conditions. Shoreline accumulation above threshold concentrations is also predicted for the Ningaloo Coast. This locations offer a number of amenities such as fishing, swimming 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, there could be restricted access to beaches for a period of days to weeks, until natural weathering or tides and currents remove the hydrocarbons. In 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 potential for stakeholder perception that this remote environment will be contaminated over a large area and for the longer term resulting in a prolonged period of tourism decline. Oxford Economics (2010) assessed the duration of hydrocarbon spill-related tourism impacts and found that on average, it took 12 to 28 months to return to baseline visitor spending. There is likely to be significant impacts to the tourism industry, wider service industry (hotels, restaurants and their supply chain) and local communities in terms of economic loss as a result of spill impacts to tourism. Recovery and return of tourism to pre-spill levels 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).
	Cultural Heritage There are a number of historic shipwrecks identified in the vicinity of Operational Area 1, with the closest to Operational Area 1 being the Beatrice, located approximately 9 km away. Shipwrecks occurring in the subtidal zone will be exposed to entrained and 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, The consequences of such hydrocarbon exposure may include all or some of the following: large fish species moving away 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). Accumulated hydrocarbons above threshold concentrations (>100 g/m^2) are predicted at Ningaloo Coast. It is acknowledged that the 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 (CALM, 1990). Additionally, artefacts, scatter and rock shelter are contained on Barrow and Montebello islands (no contact by surface hydrocarbons or accumulated hydrocarbons predicted for these areas). Within the EMBA a number of places are designated World, National and Commonwealth heritage places (**Section 4.5.1**) These places are also covered by other designations such as WHA, marine parks, and listed shipwrecks. Potential impacts have, therefore been discussed in the sections above.
Summary of Potential Impacts to environmental values(s)	
In the unlikely event of a major hydrocarbon spill due to a loss of well containment, the EMBA includes the areas listed in **Table 6-11**, including but not limited to, the sensitive marine environments and associated receptors of the Ningaloo Coast, Shark Bay, and any sensitive receptors in the open waters amongst these key receptor locations. In summary, long-term impacts may occur at sensitive nearshore and shoreline habitats, particularly, areas of the Ningaloo Coast, as a result of a major spill of hydrocarbon from the Petroleum Activities Program. The overall environmental consequence is defined as B 'Major, long-term impact (10–50 years) on highly valued ecosystem, species, habitat, physical or biological attributes' (**Table 2-3**).	

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				
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP).	F: Yes CS: Minimal cost. Standard practice.	Compliance with an accepted WOMP will ensure a number of barriers are in place and verified, reducing the likelihood of loss of well integrity occurring. Although the consequence of a blowout would not be reduced, the reduction in likelihood reduces the overall risk.	Benefits outweigh cost/sacrifice.	Yes C 9.1
Woodside Engineering Standards Well Barriers specifies the process to be undertaken to maintain an overbalance on the reservoir during well intervention .	F: Yes CS: Minimal cost. Standard practice for Woodside activities	Implementing equipment and procedures will reduce the likelihood and consequence of a well kick.	Benefits outweigh cost/sacrifice.	Yes C 9.2
Woodside Relief Well Planning Procedure details specifications for well design to assess the feasibility of performing a well kill operation.	F: Yes CS: Minimal cost. Standard practice.	Assessment of the feasibility considerations for relief well kill will reduce the duration of a spill, resulting in a reduction in consequence and overall risk.	Benefits outweigh cost/sacrifice	Yes C 10.1
Good Practice				
Subsea BOP specification and function testing is undertaken in accordance with internal Woodside Standards and international requirements: • original equipment manufacturer (OEM) standards • Woodside Engineering Standard – Rig Equipment • Woodside Engineering Manual – Well Control Manual • API Standard 53 4th Edition. These documents include detailed requirements for surface and subsea BOP function and testing, to	F: Yes CS: Minimal cost. Standard practice for Woodside activities	Implementing specification and function testing will reduce the likelihood of loss of well integrity occurring. Although the consequence of a blowout would may be reduced, the reduction in likelihood reduces the overall risk.	Benefits outweigh cost/sacrifice.	Yes C 10.2

[22] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[22]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
prevent and respond to any loss of well containment.				
Mitigation: Oil Spill Response	Refer to **Appendix D**			
Professional Judgement – Eliminate				
Do not undertake well intervention	F: No. While the current condition of the wells is such that they can be safely shut in, the option to undertake well intervention must be retained to allow Woodside to undertake well interventions if required to maintain the wells in a secure state and facilitate future decommissioning. CS: Not considered – control not feasible	Not considered – control not feasible	Not considered – control not feasible	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
Risk Based Analysis				
A quantitative spill risk assessment was undertaken (refer to **Section 6.6.2.1**)				
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 performed in line with these policies, standards and procedures that include suitable controls to prevent loss of well integrity, and response should a loss of well integrity occur.				
Societal Values				
Due to the Petroleum Activity Program's proximity to sensitive receptors (e.g. Ningaloo Coast) and the potential extent of the EMBA, the loss of well containment current risk rating presents a Decision Type C in accordance with the decision support framework described in **Section 1.10.1.2**. Extensive consultation was undertaken for this program to identify the views and concerns of relevant stakeholders, as described in **Section 5**. Woodside conducts consultation with relevant stakeholders. This consultation, conducted in 2017 and 2019 has been reviewed. Woodside sent a consultation information sheet to all identified relevant stakeholders regarding the Petroleum Activity Program (**Section 5** and **Appendix F**). Woodside has consulted with AMSA and WA DoT on spill response strategies. In accordance with the Memorandum of Understanding between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan (**Appendix H**) 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 (i.e. Decision Type C), Woodside considers the adopted controls appropriate to manage the impacts and risks of an extremely low likelihood unplanned hydrocarbon release as a result of a loss of well integrity. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability

Acceptability Statement

Loss of containment has been evaluated as having a high level of current risk rating. As per **Section 2.7**, Woodside considers high current 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 following considerations:

<u>Principles of Ecological Sustainable Development (ESD)</u>

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 lease agreement that Woodside has determined the potential to explore 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, Dampier Archipelago and the Kimberley Region, including Rankin Bank 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 processes, Woodside considers that despite this risk, the extremely low likelihood of loss of well containment is acceptable.

<u>Internal Context</u>

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, Environment and Quality Policy (**Appendix A**)
- Woodside Risk Management Policy (**Appendix A**)
- Oil spill preparedness and response strategies are considered applicable to the nature and scale of the risk and associated impacts of the response are reduced to ALARP (**Appendix D**).

Monitoring and Evaluation (operational monitoring) as a key response in the unlikely event of a hydrocarbon release will assess and track the extent of the hydrocarbon contact and revise the predicted extent of impact.

In addition, the Planning Area for scientific monitoring (refer to Section 5.7 of the Oil Spill Assessment and Mitigation Plan; **Appendix D**) can be re-assessed in the unlikely event of hydrocarbon release with consideration of the natural values and social-cultural values of state and Commonwealth protected areas (including AMPs), National and Commonwealth Heritage Listed places; tourism and recreation; and fisheries. The post-response scientific monitoring program (SMP) will consider assessment and monitoring in line with the affected receptors such as habitat and species, AMPs, fisheries.

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 HSE when making decisions. Stakeholder consultation, outlined below, has been performed prior to the Petroleum Activities Program.

<u>External Context – Societal Values (includes environmental consequence and stakeholder expectations)</u>

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 Memorandum of Understanding between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan (**Appendix H**) was provided to AMSA and DoT.
- Other relevant stakeholders have been consulted (**Section 5**) and their feedback incorporated into this EP where appropriate.
- The impact assessment has determined that the likelihood of a major long-term environmental impact on the offshore environment or sensitive nearshore and shoreline habitats from a loss of well integrity is unlikely.
- By providing additional measures to prevent loss of well integrity, in addition to oil spill response measures that are commensurate with the current risk rating, location and sensitivity of the receiving environment (including social and aesthetic values), Woodside believes this addresses societal concerns to an acceptable level.

<u>Other Requirements (includes laws, policies, standards and conventions)</u>

Demonstration of Acceptability
The Petroleum Activities Program is consistent with laws, policies, standards and conventions, including: • Subsea BOP function testing in accordance with API Standard 53, 4th Edition. • Mutual aid Memorandum of Understanding for relief well drilling is in place. Woodside develops a Relief Well Plan that covers the activity, which is signed off by the Drilling Engineering Manager and maintains a list of rigs that are currently operating in Western Australia. • Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted Well Operations Management Plan (WOMP). • Notification of reportable and recordable incidents to NOPSEMA, if required, in accordance with **Section 7.8**. • As demonstrated in **Section 6.8**, the residual risk of unplanned hydrocarbon release from loss of well containment is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 10 No loss of well containment resulting in loss of hydrocarbons to the marine environment during Petroleum Activities Program	**C 9.1** Refer to **Section 6.6.1.7.**	**PS 9.1** Refer to **Section 6.6.1.7.**	**MC 9.1.1** Refer to **Section 6.6.1.7**. **MC 9.1.2** Refer to **Section 6.6.1.7**.
	C 9.2 Refer to **Section 6.6.1.7**.	**PS 9.2** Refer to **Section 6.6.1.7**.	**MC 9.2.1** Refer to **Section 6.6.1.7**.
	C 10.1 Woodside Relief Well Planning Procedure details specifications for well design to assess the feasibility of performing a well kill operation.	**PS 10.1** An approved Relief Well Plan (as required by Relief Well Planning Procedure) shall exist prior to undertaking well intervention activities, including: feasibility and any specific considerations for relief well kill and well capping.	**MC 10.1.1** A Relief Well Plan approved by the Drilling Engineering Manager.
	C 10.2 Subsea BOP specification and function testing is undertaken in accordance with internal Woodside Standards and international requirements: • original equipment manufacturer (OEM) standards • Woodside Engineering Standard – Rig Equipment • Woodside Engineering Manual – Well Control Manual • API Standard 53 4th Edition. These documents include detailed requirements for surface and subsea BOP function and testing, to prevent and respond to any loss of well containment.	**PS 10.2** BOP installed during well intervention activities. To ensure no loss of hydrocarbons from loss of well containment, the BOP shall have, at minimum: • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems. Detailed specifications and function testing shall be in accordance with the minimum standards for the expected	**MC 10.2.1** Records demonstrate that BOP and BOP control system specifications and function testing were undertaken in accordance with minimum standards for the expected well conditions. Compliance with OEM, Woodside and API Criteria.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		well conditions, as detailed in the Woodside Engineering Standard – Rig Equipment, Woodside Engineering Well Control Manual, original equipment manufacturer (OEM) standards and API Standard 53 4th Edition.	
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**.			

6.6.2.3 Unplanned Hydrocarbon Release: Loss of Well Containment due to Accidental Damage to, or Removal of, Xmas Tree during Well Intervention Activities within Operational Area 1

Context		
Well Intervention and – **Section 3.6** Interference with or Displacement of Other Users – **Section 6.6.1.1** Disturbance to Seabed from Dropped Objects – **Section 6.6.2.9**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4** Socio-economic – **Section 4.5** Values and Sensitivities – **Section 4.6**	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*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Loss of well containment due to accidental damage to, or removal of, Xmas Tree resulting from anchor drag or dropped object during well intervention activities.		X	X		X	X	X	A	D	0	L	LCS GP PJ RBA SV	Broadly acceptable	EPO 11

Description of Source of Risk

Credible Scenario – Loss of Well Containment due to Accidental Removal of Xmas Tree During Well Intervention Due to Anchor Drag or Dropped Object

All subsea wells currently have the Xmas Tree retained in situ following cessation of production, with no wells currently having any deep-set plugs installed below the wellhead. The Xmas Tree, along with the SCSSSV, provides barriers between the reservoir and the environment. Wells plugged during the Petroleum Activities Program will have barriers established via the installation of wireline plugs, cement plugs, or a combination of both, with the Xmas Tree planned to be retained following installation of the barriers.

During well intervention activities, an uncontrolled subsea release to the marine environment following accidental damage to, or removal of, a subsea Xmas Tree due to MODU anchor drag or dropped object has the potential to occur for any of the 18 wells. The maximum credible loss of containment from this scenario is a subsea release of 4897 m^3 at a maximum release rate of about 64 m^3 per day over a 77-day period. The release would occur as an ongoing leak from the annulus from a passing gas lift valve in the production tubing, with the credible duration assessed as consistent with a loss of well containment during intervention activities (**Section 6.6.2.2**).

The worst-case release scenario volume is for an accidental, complete removal of the Xmas Tree and wellhead with the SCSSSV closed due to external impact from MODU anchor drag/dropped object during well intervention activities. In this scenario the release pathway for the well fluids flow is via the non-sealing downhole gas lift valve through the well annulus to the environment at the well location. The release rate provided assumes a release from the Enfield's highest producing well (ENA01), which has a 95% water cut (as per the latest reservoir testing).

If this scenario occurs after installing a deep-set plug while the MODU is completing well intervention activities, the potential release volume would be further restricted to the volume in the well bore between the deep-set plug and the Xmas tree. In this scenario a total volume of about 16 m^3 would be released instantaneously. This scenario is considered to be assessed in the maximum credible spill scenario above.

Any Woodside or oil and gas industry activity that results in a dropped object or anchor drag will trigger further action (further inspection and notification) to address any potential damage to infrastructure. Therefore, it is not credible that

any Woodside or industry activity in the area would result in an unreported incident resulting in a release duration longer than 77 days.
Impact Assessment
Potential Impacts Overview
Section 6.6.2.2 provides a detailed assessment of the potential impacts from a hydrocarbon release resulting in a loss of well control during well intervention, and describes potential impacts. Impacts from the credible worst-case hydrocarbon spill scenario that may arise from loss of well control due to accidental damage to, or removal of, a subsea Xmas Tree (4897 m^3) have been inferred from the loss of well containment during well intervention (14,456 m^3) (**Section 6.6.2.2**).This is considered to provide a suitable basis for assessing environmental impacts, given the nature and scale of the credible worst-case spill scenario resulting from accidental removal of the Xmas Tree with no deep-set plug in place. The biological consequences of a release of Enfield crude from the accidental removal of the Xmas Tree on open water sensitive receptors relate to the potential for minor impacts to megafauna, plankton and fish populations (water column biota) in the vicinity of Operational Area 1. No impacts to other users, such as commercial fishing or oil and gas operators are expected due to the expected localised extent of the spilled hydrocarbons.
Potential impacts to environmental values
In the unlikely event of an unplanned hydrocarbon release to the marine environment due to loss of well containment resulting from Xmas Tree damage or removal, and given the adopted controls, it is considered that any potential impact would be minor and short-term in nature to water quality in comparison to background levels and/or international standards with minor and short-term impacts to habitats, populations and shipping/fishing concerns. The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to loss of containment due to wellhead damage, as classified in **Table 2-3**, is defined as D, which equates to 'minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystem function), physical or biological attributes'. This scenario has a likelihood of remote which takes into consideration the water depth (400–600 m), limited presence of third party marine users in the area. While the risk ranking of an undetected leak from a well is low, additional controls have been considered in order to reduce the overall timeframe of the leak scenario.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[23]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP).	F: Yes CS: Minimal cost. Standard practice.	Compliance with an accepted WOMP will ensure a number of barriers are in place and verified, reducing the likelihood of loss of well integrity occurring. Although the consequence of a blowout would not be reduced, the reduction in likelihood reduces the overall risk.	Control based on legislative requirements – must be adopted	Yes C 9.1
Good Practice				
In the event of a loss of hydrocarbons to the marine environment from wellhead damage. Woodside will implement procedures	F: Yes CS: Minimal cost. Standard practice.	Implementation of WOMP including implementation of "Responding to Failure" Philosophy.	Benefits outweigh cost/sacrifice	Yes C 11.1

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[23]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
outlined in the WOMP to ensure any release is minimised to an ALARP and acceptable level, including implementation of the following “Responding to Failure” Philosophy; 1. Make the well safe / establish technical integrity in accordance with the Managing Well Integrity (Operate Phase) Procedure. 2. Communicate/ notify internal/external stakeholders as required (and in accordance with Division 8 of the OPGGS Legislation Amendment (Well Operations) Regulation 2015). 3. Determine, through further diagnostics, analyses, and risk assessments, how integrity is best managed, through the MoC System (including consideration of Environmental Risks and determination of Well Control Incident Classification Level (as per Table 29 from WOMP)) in accordance with the Managing Well Integrity (Operate Phase) Procedure. 4. Where further action is required initiate well control response in line with Well Control Incident Classification Level. 5. Where required for Level 2 or 3 events activate the Source Control Emergency Response Planning Guideline.		will resulting in a reduction in consequence and overall risk.		
Integrity visual Inspection of subsea wells on a three-yearly basis.	F: Yes CS: Significant. (AU$640,000 per inspection)	Inspection may reduce the likelihood of a spill occurring from a suspended well. Although changes in consequence would occur, the reduction in likelihood results in a reduction in overall risk.	Benefits outweigh cost/sacrifice. Three-yearly inspection aligns with Woodside subsea integrity standards.	Yes C 11.2
Inspection frequency of all subsea wells to be increased	F: Control is feasible. CS: An additional AU$640,000 per	Annual Inspection will not significantly reduce the likelihood	There is no overall risk reduction from the implementation	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[23]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
from every three years to annually.	inspection) required to increase the frequency of inspections to annual	of a spill occurring from a suspended well. Although changes in consequence may occur, the increase in inspection frequency will not reduce the overall risk.	of this control however the duration of the leak will be reduced from potentially five years (worst case) to one year. Due to the remote likelihood of this event from occurring and the cost associated with the implementation of this control, any benefit is considered disproportionate to the cost/sacrifice.	
Use of satellite imagery to detect hydrocarbon leak	F: Control is not considered feasible as it requires surface expression of oil which is not anticipated. Kongsberg Satellite Services only detects surface oil, not entrained or dissolved. Consideration of increasing the frequency of satellite imagery is not considered feasible as it requires surface expression of oil which is not anticipated. CS: Not considered as control is considered not feasible.	n/a. Control is not considered feasible.	n/a. Control is not considered feasible.	No
Use of surface glider fitted with fluorometer to detect any hydrocarbon leak. Surface glider would be programmed at a periodic interval to upload data via satellite to Woodside online maps.	F: Control is not feasible. Surface glider does not take measurements at depth therefore it is not considered feasible for a leak scenario from a wellhead. CS: Not considered as control is considered not feasible.	Not considered – control not feasible	Not considered – control not feasible	No
Use of in-water glider fitted with fluorometer to detect any hydrocarbon leak. In-water glider would undertake continuous field measurements. Programmed interval for upload via satellite to Woodside online maps.	F: control is feasible as the technology is available. There are some limitations with the technology around its reliability for the period of time required in the field and the accuracy of detection.	In-water glider Inspection will not reduce the likelihood of a spill occurring from a suspended well. Although changes in consequence may occur, the increase in inspection frequency	There is no overall risk reduction from the implementation of this control however the duration of the leak will be reduced. Due to the cost associated with the implementation of	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[23]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: the presence of an in-water glider in the field for a 180-day survey (including vessel charter and all incidental project costs) is approximately AU$396,000. In order to increase the monitor's in-field presence to be available all year, the cost is estimated to be around AU$700,000 annually.	will not reduce the overall risk.	this control, any benefit from the presence of an in water hydrocarbon detection monitor is considered disproportionate to the cost/sacrifice.	
Use of fixed subsea detection monitor fitted with surface buoy. Programmed surfacing to upload via satellite to Woodside online maps.	F: this control is considered feasible but is not a proven technology in Woodside. CS: estimated cost is AU$350,000 per year for one monitor. As the monitors are acoustic, there will be multiple sensors required to cover the field. In order for this control to be effective, it will require real time data via a surface buoy. Expected cost to AU$1.2 million to mobilise four monitors with real time data acquisition.	Fixed subsea detection monitor will not reduce the likelihood of a spill occurring from a suspended well. Although changes in consequence may occur, the increase in inspection frequency will not reduce the overall risk.	There is no overall risk reduction from the implementation of this control however the duration of the leak will be reduced from potentially five years (worst case) to one year. Due to the remote likelihood of this event from occurring and the cost associated with the implementation of this control, any benefit is considered disproportionate to the cost/sacrifice.	No
Contract existing Woodside helicopter operating in Exmouth to undertake visual observations around the Enfield location in order to identify any potential hydrocarbon sheens on the water surface.	F: Control is not considered feasible as it requires surface expression of oil and the presence of a trained observer in order to provide an accurate observation. CS: Not considered as control is considered not feasible.	Not considered – control not feasible	Not considered – control not feasible	No
Contract existing Woodside supply vessels to undertake visual observations around the Enfield location in order to identify any potential hydrocarbon sheens on the water surface.	F: Control is not considered feasible as it requires surface expression of oil and the presence of a trained observer in order to provide an accurate observation. CS: Not considered as control is considered not feasible.	Not considered – control not feasible	Not considered – control not feasible	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[23]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Utilise nearby Woodside facility or standby vessels to maintain monitoring of the gazetted NGA petroleum safety zone around the Enfield subsea infrastructure to prevent third party vessels from entering the area of the wells.	F: This control is feasible. Monitoring of the petroleum safety zone will need to be maintained in order to make this control effective. The nearby Ngujima Yin FPSO (7 km) could be tasked with maintaining watch of the petroleum safety zone, or as an alternative a standby vessel could be used. CS: Minor cost associated with utilising the Ngujima Yin FPSO to monitor the petroleum safety zone, additional effort is required for the facility to maintain watch over both its own petroleum safety zone as well as the additional safety zone of NGA. Significant cost associated with continued use of a dedicated standby vessel.	Constant monitoring may reduce the likelihood of a spill occurring from a suspended well. Although changes in consequence may occur, the increase in monitoring will not reduce the overall risk.	Costs associated with the implementation of monitoring control for gazetted zones is considered disproportionate given the minor overall risk reduction associated with the implementation of such a control.	No
Implementation of geofencing software to monitor presence of third party vessels. Description: Use of geofencing software to create a virtual boundary, enabling Woodside to be alerted when a third party vessel enters the field and is in the vicinity of the wells.	Feasibility: Control would be feasible however technology is not yet available. CS: Minor additional cost associated with the set up and maintenance of the software as it is an extension to existing software for Woodside. However, the software extension is currently not active therefore is not available.	Not considered – control not feasible	This control would enable Woodside to identify any vessels in the vicinity of the wells. However, as this control is not yet available it is unable to be implemented.	No
Professional Judgement – Substitute				
No additional controls identified				
Professional Judgement – Engineered Solution				
No additional controls identified				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of loss of well				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[23]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
containment from wellhead removal. Note that Woodside has considered the impacts and risks of dropped objects, an event that may lead to wellhead removal, in **Section 6.6.2.9**. 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, loss of well containment from wellhead removal represent a low current risk rating that is unlikely to result in a potential impact greater than localised, minor contamination resulting in a decrease in water quality, and the potential for minor impacts to marine fauna. No contact with sensitive receptors above impact thresholds is expected. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. As demonstrated in **Section 6.8**, the residual risk of unplanned hydrocarbon release from loss of well containment is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 11 No loss of well containment resulting in loss of hydrocarbons to the marine environment from wellhead damage.	**C 9.1** Refer to **Section 6.6.1.7.**	**PS 9.1** Refer to **Section 6.6.1.7.**	**MC 9.1.1** Refer to **Section 6.6.1.7**.
	C 11.1 In the event of a loss of hydrocarbons to the marine environment from wellhead damage. Woodside will implement procedures outlined in the WOMP to ensure any release is minimised to an ALARP and acceptable level, including implementation of the following “Responding to Failure” Philosophy; 1. Make the well safe / establish technical integrity in accordance with the Managing Well Integrity (Operate Phase) Procedure. 2. Communicate/ notify internal/external stakeholders as required (and in accordance with Division 8 of the *OPGGS Legislation Amendment (Well Operations) Regulation 2015*). 3. Determine, through further diagnostics, analyses, and risk assessments, how integrity is best managed through the MoC System (including consideration of Environmental Risks and determination of Well Control Incident Classification Level (as per Table 29 from WOMP)) in	**PS 11.1** Wells managed in compliance with the accepted WOMP, including implementation of “Responding to Failure” Philosophy.	**MC 11.1.1** Records demonstrate adherence to requirements of WOMP in the event of a loss of hydrocarbons to the marine environment from wellhead damage.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	accordance with the Managing Well Integrity (Operate Phase) Procedure. 4. Where further action is required initiate well control response in line with Well Control Incident Classification Level. 5. Where required for Level 2 or 3 events activate the Source Control Emergency Response Planning Guideline.		
	C 11.2 Integrity visual inspection of subsea wells on a three-yearly basis.	**PS 11.2** Wells inspected on a three-yearly basis to monitor for leaks and to ensure integrity is maintained.	**MC 11.2.1** Subsea three-yearly inspection report.
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**.			

6.6.2.4 Unplanned Hydrocarbon Release: Vessel Collision within Operational Area 1

Context		
RTM – **Section 3.7** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4** Socio-economic – **Section 4.5** Values and Sensitivities – **Section 4.6**	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***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Loss of hydrocarbons to marine environment due to a vessel collision (e.g. activity support vessels or other marine users) within Operational Area 1.			X		X	X	X	A	D	1	M	LCS GP PJ RBA	Broadly acceptable	EPO 2, 3 and 12
Loss of hydrocarbons to marine environment due to a vessel collision with the RTM (e.g. other marine users) within Operational Area 1.			X		X	X	X	A	D	1	M			

Description of Source of Risk

Background

Project vessels will use marine diesel fuel. The MODU has a total marine diesel capacity of approximately 1000 – 1500 m^3 that is distributed through a number of isolated tanks. MODU fuel tanks are located in the MODU pontoons, typically located on the inner sides of pontoons and can be over 10 m below the waterline.

A typical PIV vessel is likely to have multiple isolated marine diesel tanks distributed throughout the hull of the vessel. Individual marine diesel tanks are typically less than 500 m^3 in volume; however for the purposes of a conservative indication of the risks associated with a vessel collision for the Petroleum Activities Program, Woodside has assumed a largest marine diesel tank volume of 500 m^3 for the PIV. In the unlikely event of a vessel collision involving a PIV during the Petroleum Activities Program, the vessels will have the capability to pump marine diesel from a ruptured tank to a tank with spare volume in order to reduce the potential volume of fuel released to the environment.

The marine diesel storage capacity of activity support vessels can also be in the order of 1000 m^3 (total) that is distributed through multiple isolated tanks typically located mid-ships and can range in typical size from 22 to105 m^3.

Project vessels (including the MODU) will be intermittently present in Operational Area 1 for the duration of the Petroleum Activities Program. This intermittent presence in the area will result in a navigational hazard for commercial shipping within the immediate area (as discussed in **Section 4.4.1**).

While the RTM remains on station, it may present a navigational hazard for commercial shipping within the immediate area. Operational exclusion zone of 500 m is in place and reflected on navigational charts. Navigational lights and passive reflective radar are installed and in working condition. In the event the RTM loses integrity of an additional ballast compartment, it could sink by ~1.5 m to approximately 5 m above the waterline; if a further (third) ballast compartment failed, it could sink to approximately 5 m below the water line where it would present a submerged hazard to commercial shipping within the immediate area.

Industry Experience

Registered vessels or foreign flag vessels in Australian waters are required to report events to the Australian Transport Safety Bureau (ATSB), AMSA or Australian Search and Rescue.

From a review of the ATSB marine safety and investigation reports, one vessel collision occurred in 2011–2012 that resulted in a spill of 25–30 L of oil into the marine environment as a result of a collision between a tug and activity support vessel off Barrow Island. Two other vessel collisions occurred in 2010, one in the port of Dampier, where an activity support vessel collided with a barge being towed. Minor damage was reported and no significant injury to personnel or pollution occurred. The second 2010 vessel collision involved a vessel under pilot control in port connected with a vessel alongside a wharf causing it to sink. No reported pollution resulted from the sunken vessel. These incidents demonstrate the likelihood of only minor volumes of hydrocarbons being released during the highly unlikely event of a vessel collision occurring.

From 2010 to 2011, the ATSB's annual publication defines the individual safety action factors identified in marine accidents and incidents: 42% related to navigation action (2011). Of those, 15% related to poor communication and 42% related to poor monitoring, checking and documentation. The majority of these related to the grounding instances.

One instance of a vessel colliding with a navigation buoy was recorded by the ATSB in 2017, with damage to the buoy and ship limited to paintwork. No instances were found of a collision with a buoy (floating or submerged) resulting in a spill.

Credible Scenario

For a vessel collision to result in the worst-case scenario of a hydrocarbon spill from the vessel (the RTM is hydrocarbon free) potentially impacting an environmental receptor, several factors must align as follows:

- The identified causes of vessel interaction must result in a collision.
- The collision must have enough force to penetrate the vessel hull.
- The collision must be in the exact location of the fuel tank.
- The fuel tank must be full, or at least of volume which is higher than the point of penetration.

The 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 remote. Given the offshore location of Operational Area 1, vessel grounding is not considered a credible risk.

The environmental risk analysis and evaluation undertaken identified and assessed a range of potential scenarios that could result in a loss of vessel structural integrity resulting in damage to fuel storage tank(s) and a loss of marine diesel to the marine environment. The scenarios considered damage to single and multiple fuel storage tanks in the activity support vessel and MODU due to various combinations of vessel to vessel, vessel to MODU collisions and third party vessel or PIV or intervention vessel or support vessel collision with the RTM. In summary:

1. It is not a credible scenario that the total storage volume of the MODU would be lost, as fuel is stored in more than one tank.
2. It is not a credible scenario that a storage tank on the MODU would be damaged due to the location of the tanks within the hull, behind the bilge tanks, below the waterline.
3. It is not a credible scenario that a collision between the activity support vessel and MODU would damage any storage tanks, due to the location of the tanks on both vessel types, and secondary containment.
4. It is highly unlikely that the full volume of the largest storage tank on an activity support vessel would be lost.
5. It is not a credible scenario that a collision between a third party vessel / PIV / intervention vessel / support vessel and the floating RTM (12 m wide and ~6 m above waterline) would occur and result in an oil spill from the vessel.
6. It is highly unlikely that a collision between a third party vessel / PIV / intervention vessel / support vessel and the RTM if it were submerged, would occur resulting in the full volume of the largest storage tank on a the vessel.

The forth scenario considered was a collision between a project vessel and a third party vessel (i.e. commercial shipping, other petroleum-related vessels and commercial fishing vessels). This was assessed as being credible but highly unlikely given the distance of Operational Area 1 from the nearest shipping fairway (approximately 40 km away), the standard vessel operations and equipment in place to prevent collision at sea, the standby role of a support vessels (low vessel speed), the exclusion zone around the MODU and RTM and the construction and placement of storage tanks. The largest tank of the activity support vessel is unlikely to exceed 500 m^3 (**Table 6-13**).

The sixth scenario considered is in the event that the RTM lost integrity of an additional two ballast compartments, becoming a submerged hazard, where a third party vessel / PIV / intervention vessel / support vessel could collide with the RTM resulting in a loss of containment of marine diesel from the vessel. The vessel would need to impact the RTM directly resulting in significant damage to the front of the vessel and subsequent breach of the forward hull tanks. These tanks are often used for trim control and so do not typically contain fuel oil. Due to the shape of the RTM (circular profile) and stiffness of the mooring system, it is likely that any blow would be glancing resulting in damage to the immediate impact area then the RTM would be deflected by the impact and assuming no action were taken by the impacting vessel, the RTM would scrape along the side of the vessel. Wave action and resultant relative heave of the RTM and impacting vessel may exacerbate the damage caused by the RTM but the load applied would be low (caused by mooring system stiffness only).

This was assessed as being credible but highly unlikely given the RTM has been designed for surface shipping impact with compartment 13 foam filled to provide protection to the RTM/vessel should impact occur. In addition to this, the distance of Operational Area 1 from the nearest shipping fairway is approximately 40 km away, the RTM is marked on navigation charts and will remain within a marked 500 m exclusion zone while it is in Operational Area 1. Should the RTM partially submerge, a standby vessel will be deployed to monitor the RTM 500 m exclusion zone and warn vessels of the hazard until either a marker buoy is connected to the RTM, or the RTM is removed from Operational Area 1. The buoy will provide radar marking of the RTM and a visual indication on the surface that a submerged hazard exists. AMSA will be informed along with the AHO to facilitate update of charts indicating the hazard.

Table 6-13: Assessment of potential vessel spill scenarios

Scenario	Hydrocarbon Volumes	Preventative and Mitigation Controls	Credibility	Max. Possible Volume loss (m^3)
Breach of MODU fuel tanks due to activity support vessel or commercial shipping/ fisheries vessel collision.	MODU has a fuel oil storage capacity of approximately 966–1400 m^3, distributed through multiple tanks.	Fuel tanks are located on the inside of pontoons and protected by location below waterline, protection from other tanks e.g. bilge tanks. The draught of vessel and location of tanks in terms of waterline prevent the tanks from being breached.	Not credible Due to location of tanks	0
Breach of activity support vessel fuel tanks due to collision with a project vessel or MODU.	Activity support vessel has multiple marine diesel tanks typically ranging between 22 and 105 m^3 each.	Typically double wall, tanks which are located mid-ship (not bow or stern). Slow activity support vessel speeds when in close proximity to MODU / intervention vessel, PIV or activity support vessel.	Not credible Collision with MODU / intervention vessel or PIV at slow speeds is highly unlikely and if did occur is highly unlikely to result in a breach of activity support vessel (low energy contact from slow-moving vessel).	0
Breach of PIV fuel tanks due to collision with a an activity support vessel	PIV vessel has multiple isolated tanks, largest volume of a single tank is likely to be ≤500 m^3	Tank locations mid-ship (not bow or stern). For the majority of subsea installation activities the PIV will be holding location. The PIV vessels may steam within the project area at around 12 knots; however normal maritime procedures would apply during such vessel movements.	Not credible Collision with activity support vessels at slow speeds is highly unlikely and if did occur is highly unlikely to result in a breach of PIV (low energy contact from slow-moving vessel)	0
Breach of PIV, intervention vessel or activity support vessel fuel tanks due to activity support vessel – other vessel collision including commercial shipping/ fisheries	Intervention vessel, PIV and activity support vessels have multiple marine diesel tanks typically ranging between 22 and 500 m^3 each.	Typically double wall, tanks which are located mid-ship (not bow or stern) Vessels are not anchored and steam at low speeds when relocating within the Operational Areas or providing stand-by cover. Normal maritime procedures would apply during such vessel movements	Credible Project vessel – other vessel collision could potentially result in the release from a fuel tank	500 m^3

Breach of third party vessel / PIV / intervention vessel / support vessel fuel tank due to a collision with RTM	Third party vessels assumed to be equal or smaller than a PIV, intervention vessel or activity support vessel (between 22 and 500 m^3 each).	RTM is marked on navigation charts and within a 500 m exclusion zone. Also has navigation lights and a passive reflective radar. Compartment 13 is foam filled to provide protection to the RTM/vessel should impact with a vessel occur.	Not credible	0
Breach of third party vessel / PIV / intervention vessel / support vessel fuel tank due to a collision with submerged RTM	Third party vessels assumed to be equal or smaller than a PIV, intervention vessel or activity support vessel (between 22–500 m^3 each).	RTM is marked on navigation charts and within a 500 m exclusion zone. Compartment 13 is foam filled to provide protection to the RTM/vessel should impact with a vessel occur.	Credible Third party vessel / PIV / intervention vessel / support vessel collision could potentially result in the release from a fuel tank.	500 m^3

Quantitative Hydrocarbon Risk Assessment

Modelling was undertaken by RPS APASA, on behalf of Woodside, to determine the fate of marine diesel released from a collision within Operational Area 1. The modelling assessed the extent of marine diesel spill volume of 500 m^3 for all seasons, using an historic sample of wind and current data for the region. A total of 200 simulations in various seasons were modelled with each simulation tracked for 42 days.

Hydrocarbon characteristics

Marine diesel is a mixture of both volatile and persistent hydrocarbons. Predicted weathering of marine diesel, based on typical conditions in the region, indicates that approximately 50% by mass would be expected to evaporate over the first day or two (**Figure 6-2**). After this time the majority of the remaining hydrocarbon is entrained into the upper water column. In calm conditions, entrained hydrocarbons are likely to resurface. Seven days following the spill, approximately 45–50% would evaporate, 40–45% would entrain and approximately 10% would decay and a small proportion would be dissolved (**Figure 6-2**).

Given the environmental conditions experienced in Operational Area 1, marine diesel is expected to undergo rapid spreading and this, together with evaporative loss, is likely to result in a rapid dissipation of the spill. Marine diesel distillates tend not to form emulsions at the temperatures found in the region. The characteristics of the marine diesel used in the modelling are given in **Table 6-14**.

Table 6-14: Characteristics of the marine diesel used in the modelling

Hydrocarbon Type	Initial Density (g/cm^3) at 25°C	Viscosity (cP @ 25°C)	Component BP (°C)	Volatiles <180	Semi volatiles 180–265	Low Volatility (%) 265–380	Residual (%) >380
				Non-Persistent			Persistent
Marine Diesel (surrogate for MGO)	0.829	4.0	% of total	6	34.6	54.4	5

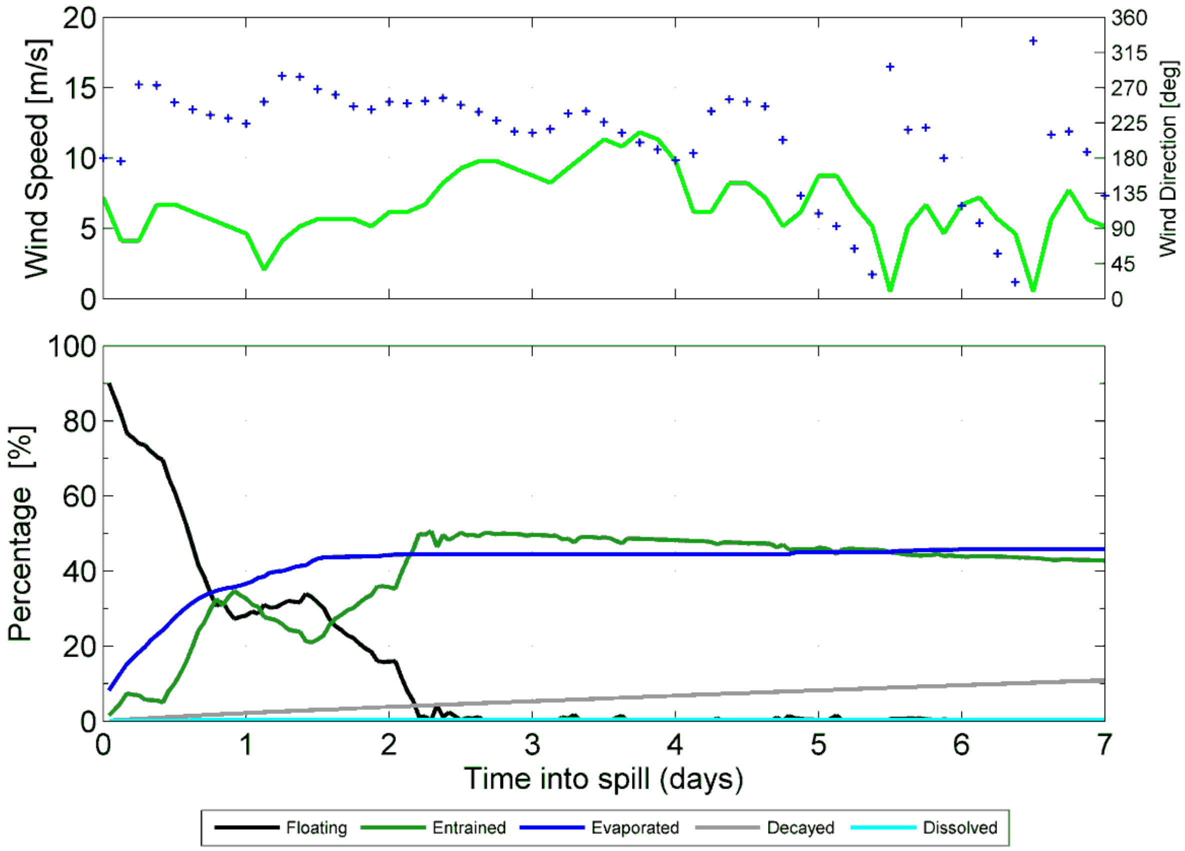

Figure 6-2: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over one hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature

Impact Assessment

Potential Impacts Overview

Environment that May Be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling, which compiles data from 100 hypothetical worst-case spills under a variety of weather and metocean conditions (as described in **Section 6.6.2.1**] Therefore, the EMBA covers a larger area than the area that would be affected during any one single spill event, and thus represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs. The trajectory of a single spill would have a considerably smaller footprint.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean transport mechanism, a different EMBA is discussed for each fate.

Surface hydrocarbons

In the event that this scenario occurred, a surface hydrocarbon slick would form down current of the release location with the trajectory dependent on prevailing wind and current conditions at the time. The modelling indicates that the spill would be localised and confined to open water, extending up to approximately 150 km from the release location.

Entrained hydrocarbons

In the event that this vessel collision scenario occurred, the probability of contact by entrained oil at concentrations above 100 ppb is predicted to be 1–7% at receptors associated with the Ningaloo Coast, 18% at the Gascoyne AMP, and 1% at Shark Bay AMP/WHA, Muiron Islands AMP, Abrolhos Islands AMP, and Carnarvon Canyon AMP.

Dissolved hydrocarbons

Dissolved hydrocarbons above threshold concentrations (>500 ppb) were not predicted by the modelling to occur at any location. Therefore, no contact with any sensitive receptors is predicted.

Accumulated hydrocarbons

Accumulated hydrocarbons above threshold concentrations (>100 g/m^2) were predicted by the modelling to occur at Ningaloo Reef and the Muiron Islands. The largest potential volume of oil accumulating on any shoreline is expected to be 196 m^3 at Ningaloo Coast North. Large potential volumes are also potentially forecast at the Muiron Islands (38 m^3).

Potential impacts to environmental values

The potential biological and ecological impacts associated with hydrocarbon spills are presented in **Section 6.6.2.2.** Further detail on impacts specific to a spill of marine diesel are provided below. It is noted that the toxic components in marine diesel include alkylated naphthalenes which can be rapidly accumulated by marine biota including invertebrates such as marine oysters, clams, shrimp, as well as a range of vertebrates, such as finfish. Marine diesel also contains additives that contribute to its toxicity.

Protected Species

As identified in **Section 4.4.3,** protected species, including pygmy blue whales, humpback whales, whale sharks, and marine turtles may be encountered within Operational Area 1 and, therefore, could be impacted by a marine diesel spill. Although the EMBA may spatially overlap with the BIAs identified in **Section 4.4.3**, it is considered that protected species that are present will be predominantly transiting through the area. Additionally, the EMBA may overlap with the whale shark aggregation area (March to July) off the Ningaloo Coast. In the event that marine fauna come into contact with a release, they could suffer fouling, ingestion, inhalation of toxic vapours, irritation of sensitive membranes in the eyes, mouth, digestive and respiratory tracts and organ or neurological damage. Given the dilution and weathering of any spill, the likelihood of ecological impacts to marine fauna (protected species), it is expected that any potential impacts will be low magnitude and temporary in nature.

Other Habitats, Species and Communities

Within the EMBA for a marine diesel spill resulting from a vessel collision, there is the potential for plankton communities to potentially be impacted where entrained hydrocarbon threshold concentrations are exceeded. Communities are expected to recover quickly (weeks/months) due to high population turnover (ITOPF 2011). With the relatively small EMBA and the fast population turn-over of open water plankton populations, it is considered that any potential impacts would be low magnitude and temporary in nature.

Pelagic fish populations in the open water offshore environment of the EMBA are highly mobile and have the ability to move away from a marine diesel spill. The spill affected area would likely be confined to the upper surface layers. It is therefore, unlikely that fish populations would be exposed to widespread hydrocarbon contamination. Fish populations are likely to be distributed over a wide geographical area so impacts on populations or species level are considered to be negligible. Combined with these factors, the relatively small EMBA and the rapid dispersion of marine diesel, it is considered that any potential impacts will be negligible. While other communities (e.g. demersal fish, benthic infauna and epifauna) and key sensitivities (e.g. KEFs identified in **Section 4.6.7**) may be within the EMBA, they are unlikely to be directly impacted by a marine diesel spill as hydrocarbons are confined to the top 40 m of the water column.

Water Quality

It is likely that water quality will be reduced at the release location of the spill to contamination levels above background levels and/or national/international quality standards; however, such impacts to water quality would be temporary and localised in nature due to the relatively reduced extent of the EMBA and the rapid dispersion of marine diesel. The potential impact is therefore expected to be low.

Protected Areas

The EMBA may extend into the Ningaloo Coast WHA and MPA. In the unlikely event of a spill, with surface or entrained hydrocarbons above threshold concentrations contacting the WHA or MPA, the potential impacts to ecological sensitivities are considered to be similar to those discussed above. No shoreline accumulation above threshold values is predicted for the Ningaloo coast (including the WHA).

Socio-economic

A marine diesel spill is considered unlikely to cause significant direct impacts on the target species fished by the Commonwealth and State Fisheries (see **Table 4-10**) which overlap with the EMBA. Active fisheries within the EMBA primarily target demersal and benthic species (finfish and crustaceans) that inhabit waters in the range of >60–200 m depth or pelagic species which are highly mobile. Therefore, a marine diesel spill due is expected to only result in negligible impacts, considering the relatively small area of the EMBA and hydrocarbons are confined to the top 40 m of the water column. However, there is the potential that a fishing exclusion zone would be applied in the area of the spill, which would put a temporary ban on fishing activities and therefore potentially lead to subsequent economic impacts on commercial fishing operators if they were planning on undertaking fishing within the area of the spill.

A loss of hydrocarbons due to vessel collision during the Petroleum Activities Program may lead to exclusion of marine nature-based tourist activities at Ningaloo coast, resulting in a loss of revenue for operators. Tourism is a major industry for the region and visitor numbers would likely reduce if a hydrocarbon spill were to occur. Given the nature of a marine diesel spill, impacts would be expected to be temporary in nature.

Summary of Potential Impacts to environmental values(s)

In the unlikely event of an unplanned hydrocarbon release to the marine environment due to vessel collision, combined with the adopted controls, it is considered that any potential impact would be minor and short-term in nature to water quality in comparison to background levels and/or international standards with minor and short-term impacts to habitats, populations and shipping/fishing concerns.

The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to vessel collision, as classified in **Figure 2-4**, is defined as D, which equates to ‘minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystem function), physical or biological attributes’.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[24]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
500 m safety exclusion zone established around MODU / intervention vessel / PIV and RTM.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Controls based on legislative requirements – must be adopted.	Yes C 2.1a
Marine Order 30 (prevention of collisions) 2016, including: • adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) • adherence to navigation light display requirements, including visibility, light position/shape appropriate to activity • adherence to navigation noise signals as required.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users and thus the likelihood of a collision.	Controls based on legislative requirements – must be adopted.	Yes C 12.1
Marine Order 21 (safety and emergency arrangements) 2016, including: • adherence to minimum safe manning levels • maintenance of navigation equipment in efficient working order (compass/radar) • navigational systems and equipment required are those specified in Regulation 19 of Chapter V of *Safety of Life at Sea* • Automatic Identification System (AIS) that provides other users with	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users and thus the likelihood of a collision.	Controls based on legislative requirements – must be adopted.	Yes C 12.2

[24] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[24]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.				
Good Practice				
Activity support vessel(s) on standby during well intervention activities to communicate with third-party vessels and assist in maintaining the safety exclusion zone.	F: Yes. CS: Minimal cost – support vessels available routinely in Operational Area 1 during Petroleum Activities Program. Standard practice.	Provides a small reduction in likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes C 2.2a
Activity support vessel(s) assigned to surveillance will undertake the following actions: • Maintain a 24 hour radio watch on designated radio channel(s) • Undertake continuous surveillance and warn the MODU / intervention vessel / PIV (as required) of any approaching vessels reaching 500 m safety exclusion zone (or warn vessel approaching submerged RTM). Surveillance shall be conducted by a combination of the following: - Visual lookout - Radar watch - Other electronic systems available including automatic identification system (AIS) - Monitoring any additional/agreed radio communications channels - All other means available. • Monitor and advise the if: - MODU / intervention vessel / PIV / RTM navigation signals are defective	F: Yes. CS: Minimal cost – support vessels available routinely in Operational Area during Petroleum Activities Program. Standard practice.	Provides a reduction in likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes C 2.3

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[24]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
- visibility becomes restricted.				
AHO notified of activity no less than four working weeks prior to undertaking activities within the Petroleum Activity Program.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHO will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 3.1
DPIRD notified of activities within three months of undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes C 3.2
AMSA notified JRCC of activities 24–48 hours of undertaking activities within the Petroleum Activity Program.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 3.3
Consultation undertaken with relevant stakeholders for activities within the Petroleum Activities Program that commence more than a year after EP acceptance	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 3.4
Ongoing monitoring of the RTM for submergence and navigation systems are operational	F: Yes CS: Minimal cost. Good practise.	Provides a reduction in likelihood of a collision vessel with the RTM if submerged as control measures able to be implemented.	Benefits outweigh cost/sacrifice.	Yes C 12.3
If the RTM becomes a submerged hazard, a standby vessel will be deployed until either a marker buoy is connected to the RTM to mark the submerged hazard, or the RTM is removed, or the	F: Yes CS: Moderate cost. Good practice.	Reduces the likelihood of a collision vessel with the RTM if submerged as control measures able to be implemented.	Benefits outweigh cost/sacrifice.	Yes C 12.4

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[24]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
navigation charts have been updated to reflect a submerged hazard.				
Mitigation: oil spill response	Refer to **Appendix D**			
Professional Judgement – Eliminate				
Sink RTM to seabed to remove hazard to prevent collision which results in a spill.	F: Yes. Sinking the RTM to the seabed would result in reduced hazard at surface. However, it may not be technically feasible to recover the RTM once on the seabed. CS: Sinking followed by recovery of the RTM for disposal would have significant cost, including the cost of procuring a vessel capable of securing and lifting the RTM from the seabed.	Although it is feasible to sink the RTM to reduce the surface hazard to other users, it will move the impact to the sea floor, and may not be technically feasible to recover.	Disproportionate. The cost/sacrifice involved with removing the RTM from the sea floor (if even possible) grossly outweighs the environmental benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Attach self-deploying marker buoy (indicating a submerged hazard) to the topsides of the RTM, which will deploy if the RTM partially submerges.	F: Yes CS: Practicable cost.	Reduces the likelihood of a collision with vessel if the RTM becomes submerged.	Benefits outweigh cost/sacrifice.	Yes C 12.5
Install a remote online RTM draft monitoring system to monitor enable the draft and location of the RTM.	F: Yes. Installing a remote monitoring system is feasible. CS: Minimal cost..	Minimal benefit as the RTM is being monitored weekly; however, there is a potential reduction in likelihood of a vessel collision as mitigation measures could be implemented sooner following submergence.	Benefits outweigh cost/sacrifice.	Yes C 12.6
Install additional redundant navigation aid system on the RTM.	F: Yes. Installing a redundant navigation aid system is feasible. CS: Minimal cost..	Minimal benefit as the RTM already has navigation aid system; however, there is a potential reduction in likelihood of a vessel collision as there is increased certainty of navigation aids being in operation.	Benefits outweigh cost/sacrifice.	Yes C 12.7
Risk Based Analysis				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[24]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
A quantitative spill risk assessment was undertaken (see details above)				
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 an unplanned loss of hydrocarbon as a result of vessel collision. 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 an unplanned loss of hydrocarbon as a result of a vessel collision represents a moderate current risk rating that is unlikely to result in potential impact greater than localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines, good oil-field practice/industry best practice, and in some cases are above industry best practice and meet legislative requirements of (Marine Orders 30 and 21). As demonstrated in **Section 6.8**, the residual risk of unplanned hydrocarbon release from vessel collision is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of a loss of vessel structural integrity to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 Prevent adverse interactions between vessels/RTM and other marine users during the Petroleum Activities Program.	**C 2.1a** Refer to **Section 6.6.1.1**	**PS 2.1a** Refer to **Section 6.6.1.1**	**MC 2.1.1a** Refer to **Section 6.6.1.1**
	C 2.2a Refer to **Section 6.6.1.1**	**PS 2.2a** Refer to **Section 6.6.1.1**	**MC 2.2.1a** Refer to **Section 6.6.1.1**
	C 2.3 Refer to **Section 6.6.1.1**	**PS 2.3** Refer to **Section 6.6.1.1**	**MC 2.3.1** Refer to **Section 6.6.1.1**
EPO 3 Marine users aware of the Petroleum Activities Program.	**C 3.1** Refer to **Section 6.6.1.1**	**PS 3.1** Refer to **Section 6.6.1.1**	**MC 3.2.1** Refer to **Section 6.6.1.1**
	C 3.2 Refer to **Section 6.6.1.1**	**PS 3.2** Refer to **Section 6.6.1.1**	**MC 3.2.1** Refer to **Section 6.6.1.1**
	C 3.3 Refer to **Section 6.6.1.1**	**PS 3.3** Refer to **Section 6.6.1.1**	**MC 3.3.1** Refer to **Section 6.6.1.1**
	C 3.4 Refer to **Section 6.6.1.1**	**PS 3.4** Refer to **Section 6.6.1.1**	**MC 3.4.1** Refer to **Section 6.6.1.1**
	C 3.5 Notify AHO and AMSA in event that the RTM becomes a submerged hazard.	**PS 3.5** Notification to AHO and AMSA of submerged RTM hazard to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners	**MC 3.5.1** Consultation records demonstrate that AHO and AMSA have been notified of RTM submerging.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		(NTM) (including AUSCOAST warnings where relevant)).	
EPO 12 No release of hydrocarbons to the marine environment due to a vessel collision associated with the Petroleum Activities Program.	**C 12.1** Marine Order 30 (prevention of collisions) 2016, including: • adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) • adherence to navigation light display requirements, including visibility, light position/shape appropriate to activity • adherence to navigation noise signals as required.	**PS 12.1** Support vessels, primary installation vessels and MODU / intervention vessel compliant with Marine Order 30 (prevention of collisions) 2016 (which requires vessels to be visible at all times) to prevent unplanned interaction with marine users.	**MC 12.1.1** Marine Assurance inspection records demonstrate compliance with standard maritime safety procedures (Marine Orders 21 and 30).
	C 12.2 Marine Order 21 (safety and emergency arrangements) 2016, including: • adherence to minimum safe manning levels • maintenance of navigation equipment in efficient working order (compass/radar) • navigational systems and equipment required are those specified in Regulation 19 of Chapter V of Safety of Life at Sea • AIS that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.	**PS 12.2** Support vessels, primary installation vessels and MODU / intervention vessel compliant with Marine Order 21 (safety of navigation and emergency procedures) 2016 to prevent unplanned interaction with marine users.	
	C 12.3 Ongoing monitoring of the RTM for submergence and navigation systems are operational	**PS 12.3** RTM is monitored weekly either visually or by other means e.g. remotely to check for submergence and check that navigation systems are operational.	**MC 12.3.1** Records demonstrate RTM is confirmed as still floating above the waterline and navigation systems are operational.
	C 12.4 If the RTM becomes a submerged hazard, a standby vessel will be deployed until either a marker buoy is connected to the RTM to mark the submerged hazard, or the RTM is removed, or the navigation charts have been	**PS 12.4** Marker buoy installed to mark the location of the submerged RTM.	**MC 12.4.1** Records demonstrate a marker buoy is installed or navigation charts are updated with submerged hazard or the RTM is removed before the standby vessel departs the submerged RTM.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	updated to reflect a submerged hazard.		
	C 12.5 Attach self-deploying marker buoy (to indicate a submerged hazard) to the topsides of the RTM, which will deploy if the RTM partially submerges.	**PS 12.5** A self-deploying marker buoy is installed to the topsides of the RTM.	**MC 12.5.1** Records demonstrate self-deploying marker buoy is installed on the RTM.
	C 12.6 Install a remote online RTM draft monitoring system to monitor the draft and location of the RTM.	**PS 12.6** Remote draft monitoring system is installed on the topsides of the RTM.	**MC 12.6.1** Records demonstrate remote draft monitoring system is installed on the topsides of the RTM.
	C 12.7 Install an additional redundant navigation aid system on the RTM.	**PS 12.7** A redundant additional navigation aid system is installed on the RTM	**MC 12.7.1** Records demonstrate an additional redundant system is installed on the RTM
EPO 3 Marine users aware of the Petroleum Activities Program.	**C 3.1** Refer to **Section 6.6.1.1**	**PS 3.1** Refer to **Section 6.6.1.1**	**MC 3.2.1** Refer to **Section 6.6.1.1**
	C 3.2 Refer to **Section 6.6.1.1**	**PS 3.2** Refer to **Section 6.6.1.1**	**MC 3.2.1** Refer to **Section 6.6.1.1**
	C 3.3 Refer to **Section 6.6.1.1**	**PS 3.3** Refer to **Section 6.6.1.1**	**MC 3.3.1** Refer to **Section 6.6.1.1**
	C 3.4 Refer to **Section 6.6.1.1**	**PS 3.4** Refer to **Section 6.6.1.1**	**MC 3.4.1** Refer to **Section 6.6.1.1**
	C 3.5 Notify AHO and AMSA if the RTM becomes a submerged hazard.	**PS 3.5** Notification to AHO and AMSA of submerged RTM hazard to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	**MC 3.5.1** Consultation records demonstrate that AHO and AMSA have been notified of RTM submerging.
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**.			

6.6.2.5 Unplanned Hydrocarbon Release: Bunkering within Operational Area 1

Context		
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological 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*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Loss of hydrocarbons to marine environment from bunkering within Operational Area 1.			X			X		A	E	3	M	LCS GP PJ RBA	Broadly acceptable	EPO 13

Description of Source of Risk

Credible Scenario

Bunkering of marine diesel for project vessels may occur within the Operational Area 1 (Note: Bunkering will not occur during towing of the RTM or during activities at the proposed IAR location). Three credible 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).
- Partial or total failure of a bulk transfer hose or fittings during bunkering, 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.
- Partial or total failure of a bulk transfer hose or fittings during helicopter refuelling could spill aviation jet fuel to the helicopter deck and/or into the marine environment. All helicopter refuelling activities are closely supervised and leaks on the helideck are considered to be easily detectable. In the event of a leak, transfer would be ceased immediately. The credible volume of such a release during helicopter refuelling would be in the order of <100 L.

Quantitative Spill Risk Assessment

Given the physical and chemical similarities, and the relatively small credible spill volumes, marine diesel is considered to be a suitable substitution for aviation jet fuel for the purpose of this environmental risk assessment. Woodside has commissioned RPS APASA to model a surface spill volume of 8 m^3 in the offshore waters of northwest Western Australia. 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 vessel collision scenario detailed in **Section 6.6.2.4**. Given this, the offshore location of Operational Area 1, 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 6.6.2.4** for a description of the characteristics of marine diesel, including detail on the predicted fate and weathering of a spill to the marine environment.

Impact Assessment
Potential impacts to environmental values
Previous modelling studies for 8 m^3 marine diesel releases, spilt at the surface as result of bunkering activities, indicated that the potential for exposure to surface hydrocarbons exceeding 10 g/m^2 was confined to within the immediate vicinity (approximately 1 km) of the release sites. Therefore, it is considered that there is no potential for contact with sensitive receptor locations above surface (10 g/m^2), entrained (500 ppb) or dissolved (500 ppb) threshold concentrations from an 8 m^3 spill of marine diesel within Operational Area 1.
Summary of Potential Impacts to environmental values(s)
The potential biological and ecological impacts associated with much larger hydrocarbon spills are presented in **Sections 6.6.2.2**, **6.6.2.3** and **6.6.2.4**, further detail on impacts specific to a spill of marine diesel from a bunkering loss are provided below. The biological consequences of such a small volume spill on identified open water sensitive receptors relate to the potential for minor impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill affected area and no impacts to commercial fisheries are expected. Refer to **Section 6.6.2.4** (potential impacts of unplanned hydrocarbon release to the marine environment from vessel collision) for the detailed potential impacts; however, the extent of the EMBA associated with a marine diesel spill from loss during bunkering will be much reduced in terms of spatial and temporal scales, and hence, potential impacts from bunkering are considered very minor.

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				
Marine Order 91 (marine pollution prevention – oil) 2014, requires Ship Oil Pollution Emergency Plan (SOPEP)/Spill Monitoring Programme Execution Plan (SMPEP) (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill entering the marine environment. Although no significant reduction in consequence could result, the overall risk is reduced.	Controls based on legislative requirements – must be adopted.	Yes C 13.1
Good Practice				
Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be linked to the MODU's preventative maintenance system. • All bulk transfer hoses shall be tested for integrity before use (tested in accordance with Original Equipment Manufacturer recommendations) and re-certified annually as a minimum. • There shall be dry-break couplings and flotation on fuel hoses.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill occurring. Although no significant reduction in consequence could result, the overall risk is reduced.	Benefits outweigh cost/sacrifice.	Yes C 13.2

[25] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[25]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
• There shall be an adequate number of appropriately stocked, located and maintained spill kits.				
Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • A completed PTW and/or Job Safety Analysis (JSA) shall be implemented for the hydrocarbon bunkering/ refuelling operation. • Visual monitoring of gauges, hoses, fittings and the sea surface during the operation. • Hose checks prior to commencement. • Bunkering/refuelling will commence in daylight hours. If the transfer is to continue into darkness, the JSA risk assessment must consider lighting and the ability to determine if a spill has occurred. • Hydrocarbons shall not be transferred in marginal weather conditions.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill occurring. Although no significant reduction in consequence could result, the overall risk is reduced.	Benefits outweigh cost/sacrifice.	Yes C 13.3
Professional Judgement – Eliminate				
No refuelling of helicopter on MODU.	F: No. Given the distance of Operational Area 1 from the airports suitable for helicopter operations, and the endurance of available helicopters, eliminating helicopter refuelling is not feasible. Helicopter flights cannot be eliminated, and may be required in emergency situations. CS: Not assessed, control cannot feasibly be implemented.	Not considered – control not feasible.	Not considered – control not feasible.	No
The MODU brought into port to refuel.	F: No. Does not eliminate the fuel transfer risk. It is not operationally practical to transit MODU back to port for	Eliminates the risk in Operational Area 1; however, moves risk to another location. Therefore, no overall benefit.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[25]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	refuelling, based on the frequency of the refuelling requirements and distance from the nearest port (Dampier 180 km). CS: Significant due to schedule delay and vessel transit costs and day rates.			
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a bunkering spill. 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 Loss of hydrocarbons to marine environment during bunkering has been evaluated as having a low current risk rating that is unlikely to result in potential impact greater than minor and temporary exceedance over national/international water quality standards and a localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity of protected species. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. As demonstrated in **Section 6.8**, the residual risk of unplanned hydrocarbon release from bunkering is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks. 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 the described emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 13 No unplanned loss of hydrocarbons to the marine environment from bunkering greater than a consequence level of E[26] during the Petroleum Activities Program.	**C 13.1** Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	**PS 13.1** Appropriate initial responses prearranged and drilled in case of a hydrocarbon spill, as appropriate to vessel class.	**MC 13.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 91.
	C 13.2 Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be linked to the MODU's preventative maintenance system. • All bulk transfer hoses shall be tested for integrity before use (tested in accordance with Original Equipment Manufacturer recommendations) and re-certified annually as a minimum. • There shall be dry-break couplings and flotation on fuel hoses. • There shall be an adequate number of appropriately stocked, located and maintained spill kits.	**PS 13.2.1** Ensure damaged equipment is replaced prior to failure.	**MC 13.2.1** Records confirm the MODU bunkering equipment is subject to systematic integrity checks.
		PS 13.2.2 Minimise inventory loss in the event of a failure.	**MC 13.2.2** Records confirm presence of dry break of couplings and flotation on fuel hoses.
		PS 13.2.3 Ensure adequate resources are available to allow implementation of SOPEP.	**MC 13.2.3** Records confirm presence of spill kits.
	C 13.3 Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • Implement a completed PTW and/or JSA for the hydrocarbon bunkering/refuelling operation. • Visually monitor gauges, hoses, fittings and the sea surface during the operation. • Check hoses prior to commencement. • Commence bunkering/refuelling in daylight hours. If the transfer is to continue into darkness, the JSA risk assessment must consider lighting and the ability to determine if a spill has occurred. • Do not transfer hydrocarbons in marginal weather conditions.	**PS 13.3** Comply with Contractor procedures for managing bunkering/helicopter operations.	**MC 13.3.1** Records demonstrate bunkering/refuelling performed in accordance with contractor bunkering procedures.
Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in **Appendix D**.			

[26] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes' as in **Figure 2-6**/**Section 2.6.3**.

6.6.2.6 Unplanned Discharge: Loss of Chemicals / Hydrocarbons from Project Vessels within Operational Area 1

Context	
Well Intervention Fluids – **Section 3.9.1** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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	Current Risk Rating	ALARP Tools	Acceptability	Outcome
Accidental discharge of hydrocarbons/chemicals from project vessels deck activities and equipment (e.g. cranes) and from subsea ROV hydraulic leaks within Operational Area 1.			X			X		A	E	2	M	LCS GP PJ	Broadly acceptable	EPO 14

Description of Source of Risk

Unplanned hydrocarbon and chemical spills

Deck spills can result from spills from stored hydrocarbons/chemicals or equipment. Project vessels typically store hydrocarbon/chemicals in various volumes (20 L, 205 L; up to approximately 4000–6000 L). Storage areas are typically set up with effective primary and secondary bunding to contain any deck spills. Releases from equipment are predominantly from the failure of hydraulic hoses, which can either be located within bunded areas or outside of bunded or deck areas (e.g. over water on cranes). Helicopter refuelling may also take place within Operational Area 1, on the helipad of project vessels.

Minor leaks during wire line activities (i.e. intervention activities) with a live well are described to include leaks such as:

- leaks from the lubricator, stuffing box and hose or fitting failure, which are expected to be less than 10 L (0.01 m^3)
- loss of containment – fluids – surface holding tanks
- back loading of raw slop fluids in an Intermediate Bulk Containers
- stuffing box leak / under pressure
- draining of lubricator contents
- excess grease / lubricant leaking from the grease injection head
- wind-blown lubricant dripping from cable / on deck
- lubricant used to lubricate hole.

Woodside's operational experience demonstrates that spills are most likely to originate from hydraulic hoses and have been less than 100 L, with an average volume <10 L.

Subsea spills can result from a loss of containment of fluids from subsea equipment including the BOP or ROVs. A review of these spills to the marine environment in the past 12 months showed subsea spills did not exceed approximately 26 L in Woodside's Drilling function.

The 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.

Impact Assessment
Potential impacts to environmental values
Accidental spills of hydrocarbons or chemicals from project vessels will decrease the water quality in the immediate area of the spill; however, the impacts are expected to be temporary and very localised due to dispersion and dilution in the open ocean environment. The potential biological and ecological impacts associated with large hydrocarbon spills are presented in **Section 6.6.2.2** and impacts from minor chemical spills are described in **Section 6.6.1.4**. A minor loss of hydrocarbons from deck and subsea spills will be much reduced in terms of spatial and temporal scales from impacts described in **Section 6.6.2.2**. Given the small area of the potential spill and the dilution and weathering of any spill, the likelihood of ecological impacts to marine fauna (including protected species), other communities and habitats will be limited to slight and restricted to individual animals, and temporary, localised contamination of water.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that minor hydrocarbon/chemical spills to the marine environment will not result in a potential impact to water quality greater than slight and temporary contamination above background levels, quality standards or known effect concentrations and will not result in a potential impact greater than slight and temporary disruption to a small proportion of biological populations with no impact on protected species.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[27]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 91 (marine pollution prevention – oil) 2014, requires Ship Oil Pollution Emergency Plan (SOPEP)/Spill Monitoring Programme Execution Plan (SMPEP) (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 13.1
Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/moved temporarily.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Controls based on legislative requirements – must be adopted.	Yes C 14.1
Good Practice				
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage will be collected via a closed drainage system. E.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Benefits outweigh cost/sacrifice.	Yes C 6.3
Spill kits positioned in high risk locations around the rig (near potential spill points such as transfer stations).	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine environment. The consequence is unchanged.	Benefits outweigh cost/sacrifice.	Yes C 14.2
Primary installation vessels have self-containing	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine environment.	Benefits outweigh cost/sacrifice.	Yes C 14.3

[27] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[27]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
hydraulic oil drip tray management system.		The consequence is unchanged.		
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Below-deck storage of all hydrocarbons and chemicals.	F: Not feasible. During operations there is a need to keep small volumes near activities and within equipment requiring use of hydrocarbons and chemicals and can result in increased risk of leaks from transfers via hose or smaller containers. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
A reduction in the volumes of chemicals and hydrocarbons stored onboard the vessel.	F: Yes. Increases the risks associated with transportation and lifting operations. CS: Project delays if required chemicals not on board. Increases the risks associated with transportation and lifting operations.	No reduction in likelihood or consequence since chemicals will still be required to enable activities to occur.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of the potential unplanned accidental deck and subsea spills described above. 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 an unplanned minor discharge of hydrocarbons as a result of minor deck and subsea spills represents a moderate risk that is unlikely to result in potential impact greater than slight short-term localised and temporary disruption but not impacting on ecosystem function. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines and good oil-field practice/industry best practice. As demonstrated in **Section 6.8**, the residual risk of unplanned loss of chemicals / hydrocarbons from projects vessels is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of minor unplanned deck and subsea spills to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 14 No unplanned spills to the marine environment from deck activities greater than a consequence level of E[28] during the Petroleum Activities Program.	**C 6.3** Refer to **Section 6.6.1.3**	**PS 6.3** Refer to **Section 6.6.1.3**	**MC 6.3** Refer to **Section 6.6.1.3**
	C 13.1 Refer to **Section 6.6.2.5**	**PS 13.1** Refer to **Section 6.6.2.5**	**MC 13.1.1** Refer to **Section 6.6.2.5**
	C 14.1 Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/ moved temporarily.	**PS 14.1** Failure of primary containment in storage areas does not result in loss to the marine environment.	**MC 14.1.1** Records confirms all liquid chemicals and fuel are stored in bunded/ secondarily contained areas when not being handled/moved temporarily.
	C 14.2 Spill kits positioned in high risk locations around the rig (near potential spill points such as transfer stations).	**PS 14.2** Spill kits to be available for use to clean up deck spills.	**MC 14.2.1** Records confirms spill kits are present, maintained and suitably stocked.
	C 14.3 Primary installation vessels have self-containing hydraulic oil drip tray management system.	**PS 14.3** Contain any on-deck spills of hydraulic oil.	**MC 14.2.1** Records demonstrate project installation vessels are equipped with a self-containing hydraulic oil drip tray management system.
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**.			

[28] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function, physical or biological attributes' as in **Figure 2-6**/**Section 2.6.3**.

6.6.2.7 Unplanned Discharge: Loss of Solid Hazardous / Non-hazardous Wastes within Operational Area 1

Context	
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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	Current Risk Rating	ALARP Tools	Acceptability	Outcome
Accidental loss of hazardous or non-hazardous wastes to the marine environment (excludes sewage, grey water, putrescible waste and bilge water) within Operational Area 1.			X			X		A	F	2	L	LCS GP PJ	Broadly acceptable	EPO 15

Description of Source of Risk
Project vessels will generate a variety of solid wastes including packaging and domestic wastes such as aluminium cans, bottles, paper and cardboard. Hence, there is the potential for solid wastes to be lost overboard to the marine environment. Wastes on-board are managed in accordance with the on-board waste management plan. Some wastes may be incinerated (refer to **Section 6.6.1.7**). Based on industry experience, waste items lost overboard are typically wind-blown rubbish such as container lids, cardboard etc. Such losses typically have occurred during back loading activities, periods of adverse weather and incorrect waste storage.

Impact Assessment
Potential impacts to environmental values
The potential impacts of solid wastes accidentally discharged to the marine environment include direct pollution and contamination of the environment and secondary impacts relating to potential contact of marine fauna with wastes, resulting in entanglement or ingestion and leading to injury and death of individual animals. Several migratory and threatened species were identified as occurring within Operational Area 1, including cetaceans, marine turtles and whale sharks. However, these species are expected to be transient as there are no known key aggregation areas. Operational Area 1 overlaps BIAs for humpback whales, pygmy blue whales and wedge-tailed shearwaters. However, the temporary or permanent loss of waste materials into the marine environment is highly unlikely to have a significant environmental impact, based on the types, size and frequency of wastes that could occur during the limited time the vessels will be in Operational Area 1 and the transient nature of the species present. Given this, impacts will have no lasting effect on any species or water quality.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that the accidental discharge of solid waste described will result in localised impacts not significant to environmental receptors, with no lasting effect.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[29]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards				
Project 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.	Legislative requirements to be followed reduces the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 15.1
Good Practice				
Drilling and Completions waste arrangements, which require: • dedicated space for waste segregation bins and skips to be provided on the MODU • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) to be transported from the MODU and disposed onshore.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost sacrifice.	Yes C 15.2
Installation vessel waste arrangements, which require: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost sacrifice.	Yes C 15.3
MODU/project vessel ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard. Where safe and practicable, this activity will consider: • risk to personnel to retrieve object	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an unplanned release of solid waste and therefore no change to the likelihood. Since the waste objects may be recovered, a reduction in	Benefit outweighs cost sacrifice.	Yes C 15.4a

[29] Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[29]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
• 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).		consequence is possible.		
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of accidental discharges of waste. 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, accidental discharge of solid waste represents a low current risk rating that is unlikely to result in a potential impact above localised, not significant to environmental receptors with no lasting effect. 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 (Marine Order 95). Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 15 No unplanned releases of solid hazardous or non-hazardous waste to the marine environment greater than a consequence level of F[30] during the Petroleum	**C 15.1** Project 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 15.1** MODU and project vessels compliant with Marine Order 94 and Marine Order 95.	**MC 15.1.1** Records demonstrate MODU and project vessels are compliant with Marine Order 94 and Marine Order 95 (as appropriate to vessel class).
	C 15.2	**PS 15.2**	**MC 15.2.1**

[30] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
Activities Program.	Drilling and Completions waste arrangements, which require: • dedicated space for waste segregation bins and skips to be provided on the MODU • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) to be transported from the MODU and disposed onshore.	Hazardous and non-hazardous waste will be managed in accordance with the Drilling and Completions waste arrangements.	Records demonstrate compliance against Drilling and Completions waste arrangements.
	C 15.3 Installation vessel waste arrangements, which require: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class.	**PS 15.3** Hazardous and non-hazardous waste will be managed in accordance with the Installation Vessel waste arrangements.	**MC 15.3.1** Records demonstrate compliance against Installation Vessel waste arrangements.
	C 15.4a MODU/project vessel ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard. Where safe and practicable, 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).	**PS 15.4a** Any hazardous solid waste dropped to the marine environment will be recovered where safe and practicable to do so.	**MC 15.4.1a** Records detail the recovery attempt consideration and status of any hazardous waste lost to marine environment.

6.6.2.8 Physical Presence: Vessel Collision with Marine Fauna within Operational Area 1

Context														
Project Vessels – **Section 3.10**								Biological Environment – **Section 4.4**						
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***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Accidental collision between project vessels and threatened and migratory marine fauna within Operational Area 1.						X		A	E	1	L	LCS GP PJ	Broadly acceptable	EPO 16
Description of Source of Risk														
The project vessels operating in and around Operational Area 1 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 vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth) and the type of animal potentially present and their behaviours.														
Impact Assessment														
Potential impacts to environmental values														

Vessel disturbance is a key threat to a number of migratory and threatened species identified as occurring within Operational Area 1, including cetaceans, marine turtles and whale sharks. Relevant conservation actions outlined in these plans are listed in **Table 4-4**.

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. Project vessels within Operational Area 1 are likely to be travelling <8 knots (and will often be stationary), therefore, the chance of a vessel collision with protected species resulting in a lethal outcome is considered unlikely, as fauna can move away from project vessels.

Cetaceans

No known key cetacean aggregation areas (resting, breeding or feeding) are located within or immediately adjacent to Operational Area 1; however, this area does overlap the migration BIAs for humpback and pygmy blue whales (**Section 4.4.3**). The timing of the activity could occur at any time throughout the year (all seasons); therefore, it is possible that activity will overlap with these whale migration periods (**Table 4-7**), resulting in increased numbers of pygmy blue and humpback whales transiting Operational Area 1 during migration periods.

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 NOAA 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 positioned amongst whales. Given the duration of activities within Operational Area 1 and the slow speeds at which project vessels operate, collisions with cetaceans such as pygmy blue and humpback whales are considered very unlikely.

Whale sharks

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 Operational Area 1 during their migrations to and from Ningaloo Reef. Aggregations at Ningaloo reef occur between March and November and, therefore, may overlap the timing of activities

within Operational Area 1 (December to April). Note: The defined foraging BIA (northward from Ningaloo along the 200 m isobath) is about 8 km east of the outer boundary of Operational Area 2. Given the duration of activities within Operational Area 1 and the slow speeds at which project vessels operate, collisions with transiting individual whale sharks are considered highly unlikely. ***Marine reptiles*** With the absence of potential nesting or foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals) and the water depth (400–600 m), it is considered that Operational Area 1 is unlikely to represent important habitat for marine turtles, although individuals may infrequently transit the area. Given this, impacts to marine turtles from activities within Operational Area 1 are considered to be conservatively represented by the evaluation of impacts from activities within Operational Area 2, given this area overlaps habitat critical and BIAs for these species (**Section 6.7.2.5**). ***Summary*** It is highly unlikely that vessel movement associated with the Petroleum Activities Program in Operational Area 1 will result in collisions with marine fauna. Given the avoidance behaviour commonly displayed by whales, whale sharks and turtles and the low operating speed of the support vessels (generally <8 knots or stationary, unless operating in an emergency), the consequence of any impacts will be limited to slight with no population-level effects.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that a collision, if it occurred, will not result in a potential impact greater than slight, short term (<1 year) on species, but not affecting on a population level. It is considered highly unlikely that a collision will occur.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[31]***	***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[32]: • Project vessels will not travel faster than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow-riding). • If the cetacean or turtle shows signs of being disturbed, project vessels will immediately withdraw from the caution zone at a constant speed of less than six knots. • Vessels will not travel faster than eight knots within 250 m of a whale	F: Yes. CS: Minimal cost. Standard practice.	Implementation of these controls will reduce the likelihood of a collision between a cetacean, whale shark or turtle occurring. The consequence of a collision is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 16.1

[31] Qualitative measure

[32] For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability; e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

Demonstration of ALARP				
Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[31]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
shark and not allow the vessel to approach closer than 30 m of a whale shark.				
Good Practice				
Variation of the timing of the Petroleum Activities Program to avoid whale migration periods.	F: Not feasible. Timing of activities is linked to MODU schedule. Timing of all activities is currently not determined, and due to MODU availability and operational requirements, conducting activities during migration/ nesting seasons may not be able to be avoided. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
The use of dedicated MFOs on support vessels for the duration of each activity to watch for whales and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes, however vessel bridge crews already maintain a constant watch during operations, and crew complete specific cetacean observation training. CS: Additional cost of MFOs considered unnecessary.	Given support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not significantly further reduce the risk.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of potential vessel collision with protected marine fauna. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, vessel collision with marine fauna represents a low risk rating that is unlikely to result in a potential impact to fauna greater than slight and short term, with no population-level effects. BIAs within Operational Area 1 include the humpback and pygmy blue whale migration BIAs. 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 Act Regulations 2000. As demonstrated in **Section 6.8**, the residual risk of vessel collision with marine fauna is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of vessel collision with marine fauna to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Outcomes***	***Outcomes***	***Outcomes***
EPO 16 No vessel strikes with protected marine fauna (whales, whale sharks, turtles) during the Petroleum Activities Program.	**C 16.1** EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[33]: • Project vessels will not travel faster than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow-riding). • If the cetacean or turtle shows signs of being disturbed, project vessels will immediately withdraw from the caution zone at a constant speed of less than six knots. • Vessels will not travel faster than eight knots within 250 m of a whale shark and not allow the vessel to approach closer than 30 m of a whale shark.	**PS 16.1** Compliance with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans to minimise potential for vessel strike.	**MC 16.1.1** Records demonstrate no breaches of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans.
		PS 16.2 All vessel strike incidents with cetaceans will be reported in the National Ship Strike Database (as outlined in the Conservation Management Plan for the Blue Whale—A Recovery Plan under the EPBC Act 1999, Commonwealth of Australia, 2015).	**MC 16.2.1** Records demonstrate reporting cetacean ship strike incidents to the National Ship Strike Database.

[33]For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability; e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

6.6.2.9 Physical Presence: Disturbance to Seabed from Dropped Objects or Dragged Subsea Equipment within Operational Area 1

Context	
Well intervention – **Section 3.9** RTM Removal – **Section 3.7.2** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Dropped subsea infrastructure during laydown or removal activities / dragged subsea equipment within Operational Area 1					X			A	F	1	L	LCS GP PJ	Broadly acceptable	EPO 17
Accidental sinking of the RTM during removal from Operational Area 1.					X			A	F	1	L	LCS GP PJ		

Description of Source of Risk

Dropped Objects/ Dragged Subsea Equipment

During the Petroleum Activities Program, the controlled lifting and laydown of subsea infrastructure within Operational Area 1 is expected to occur. During these activities there is the potential for subsea infrastructure to disturb the seabed (refer to **Section 6.6.1.2**). There is also the potential for objects to be dropped overboard from project vessels to the marine environment, or for subsea equipment to be dragged on the seabed. The area of disturbance to the seabed that could result could range depending on the size of the object or the distance of the dragged equipment.

In the event of a dropped object or dragged subsea equipment, there is the potential for damage to the subsea infrastructure. During the preservation period, there is the potential for dropped objects or dragged subsea equipment to rupture flushed infrastructure, which could lead to the unintentional discharge of treated seawater and minor quantities of residual hydrocarbons (refer to **Section 6.6.1.4**). In the unlikely event of interaction with a Xmas tree, there is the potential for a well loss of containment leading to the release of hydrocarbons (refer to **Section 6.6.2.3**). Note the release volume for this scenario is significantly smaller than the credible worst-case loss of well control during intervention, as the SCSSSV and / or wireline and / or cement plug(s) are assumed to be unaffected (as per the credible spill scenario presented in **Section 6.6.2.3**).

RTM Sinking

There is potential for the RTM to sink to the seabed prior to or during the removal of the structure from Operational Area 1. Given the mooring lines would still be attached, the RTM is expected to settle within the area bound by the mooring anchors.

In the highly unlikely event that the RTM sinks to the seabed, it will result in localised disturbance to the seabed at that location. The potential disturbance footprint of the RTM would be approximately 83 m by 8.5 m (i.e. approximately 700 m^2). Components and residual contaminants or plastics within the RTM are described in **Sections 6.7.1.3** and **6.7.2.1**.

Impact Assessment

Potential impacts to environmental values

In the unlikely event that a piece of subsea infrastructure was dropped to the seabed, subsea equipment is dragged along the seabed, or the RTM sinks, such an event would add to the estimated seabed disturbance footprint for planned activities (approximately 700 m^2). However, additional disturbance would be confined to Operational Area 1,

within which the seabed consists of soft sediments, widely represented throughout the region. Therefore, any cumulative impacts would be negligible, in addition to the expected disturbance footprint for planned activities (**Section 6.6.1.2**). In the unlikely event of rupturing infrastructure containing preservation fluid (treated seawater), the credible volume of discharged treated seawater is consistent with the planned discharge volume. Refer to **Section 6.6.1.4** for an assessment of the environmental risks and impacts from a discharge of treated seawater. In the unlikely event of a loss of well containment, the worst-case credible hydrocarbon release scenario is consistent with the loss of well containment presented in **Section 6.6.2.2**; refer to **Section 6.6.2.2** for an assessment of the environmental risks and impacts due to a loss of well containment during the preservation period.
Summary of Potential Impacts to Environmental Values(s)
Given the adopted controls and the predicted small footprint of a dropped object or dragged subsea equipment, it is considered that a dropped object or dragged subsea equipment will not result in a potential impact greater than negligible short-term damage of benthic subsea habitats. Refer to **Sections 6.6.1.2, 6.6.1.4** and **6.6.2.2** for discussion of seabed disturbance, treated seawater discharge and loss of well containment respectively.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[34]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
MODU/project vessel ROV, crane or support vessel may be used to attempt recovery of objects lost overboard. Where safe and practicable, this activity will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment or, ROV availability and suitable weather).	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an unplanned release and therefore no change to the likelihood. Since the objects may be recovered, a reduction in consequence is possible.	Benefit outweighs cost sacrifice.	Yes C 15.4a
The MODU/PIV work procedures for lifts, bulk transfers and cargo loading, which require: • the security of loads to be checked prior to commencing lifts • loads to be covered if there is a risk of losing loose materials • lifting operations to be conducted using the PTW and JSA systems to manage the specific risks	F: Yes. CS: Minimal cost. Standard practice.	Occurs after a dropped object event and therefore no change to the likelihood. Since the object may be recovered, a reduction in consequence is possible.	Benefits outweigh cost/sacrifice.	Yes C 17.1

[34] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[34]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
of that lift, including consideration of weather and sea state.				
MODU/PIV inductions include control measures and training for crew in dropped object prevention.	F: Yes. CS: Minimal cost. Standard practice.	By ensuring crew are appropriately trained in dropped object prevention, the likelihood of a dropped object event is reduced. No change in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes C 17.2
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks from dropped objects. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, dropped objects will not result in a potential impact greater than negligible and short-term disruption to a small area of the seabed, a small proportion of the benthic population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks to marine sediment from dropped objects to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 17 No incidents of dropped objects to the marine environment greater than a consequence level of E[35] during the	**C 15.4** Refer to **Section 6.6.2.7**	**PS 15.4** Refer to **Section 6.6.2.7**	**MC 15.4.1** Refer to **Section 6.6.2.7**
	C 17.1 The MODU/primary installation vessels work procedures for lifts, bulk transfers and cargo loading, which require:	**PS 17.1** Lifts, bulk transfers and cargo loading managed in compliance with the work procedures, including implementation	**MC 17.1.1** Records demonstrate adherence to requirements of work procedures and in accordance with PTW and JSA systems.

[35] Defined as ‘Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function, physical or biological attributes’

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
Petroleum Activities Program.	• the security of loads to be checked prior to commencing lifts • loads to be covered if there is a risk of losing loose materials • lifting operations to be conducted using the PTW and JSA systems to manage the specific risks of that lift, including consideration of weather and sea state.	of PTW and JSA systems.	
	C 17.2 MODU/primary installation vessel inductions include control measures and training for crew in dropped object prevention.	**PS 17.2** Awareness of requirements for dropped object prevention.	**MC 17.2.1** Records show dropped object prevention training is provided to the MODU/primary installation vessels.

6.6.2.10 Physical Presence: Accidental Introduction of Invasive Marine Species within Operational Area 1

Context		
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**	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***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Introduction of invasive marine species within Operational Area 1.					X	X		A	D	0	L	LCS	Broadly acceptable	EPO 18

Description of Source of Risk

IMS are a subset of NIMS that have been introduced into a region beyond their natural biogeographic range, resulting in impacts to social/cultural, human health, economic and/or environmental values. NIMS are species that can survive, reproduce, and establish founder populations. However, not all NIMS introduced into an area will thrive or cause demonstrable impacts (i.e. become IMS). Most NIMS around the world are relatively benign and few have spread widely beyond sheltered ports and harbours.

NIMS can be translocated from a donor to a recipient location by two mechanisms—within a ship's ballast water or as biofouling on a vessel's submerged surfaces or internal systems. During the Petroleum Activities Program, vessels undertaking activities will be transiting to and from Operational Area 1, potentially including mobilising from beyond Australian waters. These vessels may include the MODU, AHTs, intervention vessel, PIVs and other project support vessels (**Section 3.10**).

Introduction to Operational Area 1

Ballast water is carried in ships' ballast tanks to improve stability, balance and trim. It is taken up or discharged when cargo is unloaded or loaded, or when a ship needs extra stability in adverse weather. When a ship takes on ballast water, organisms can also be drawn into ballast tanks. Ballast water exchange involves substituting water in ship's ballast tanks using either a sequential, flow-through, dilution or other exchange method, potentially releasing ballast water at a location foreign to where it was taken on. Ballasting and deballasting a vessel is essential in achieving maximum vessel performance through a range of functions, including vessel propulsion, stress reduction on the ship's hull, stability and manoeuvrability.

Release of unmanaged ballast water could transfer a range of NIMS into a recipient environment, depending on where ballast water was taken on board. Ballast water has been recognised as a major pathway for introducing IMS into new environments, giving rise to adoption of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention), which is given effect through the Commonwealth *Biosecurity Act 2015*. The Ballast Water Convention aims to prevent the spread of IMS from one region to another by establishing standards and procedures for managing ballast water, including phasing out ballast water exchange. In Australian waters, vessels are required to demonstrate compliance to Australian Ballast Water Management Requirements (Commonwealth of Australia, 2017d) which outlines approved methods for managing ballast water in line with the Ballast Water Convention.

Previously, ballast water discharges from commercial vessels were thought to be the most significant means of translocating NIMS; however, research suggests that more NIMS translocations are attributable to vessel biofouling than from any other mechanism (Hewitt et al., 1999; 2004; Mineur et al., 2007). Biofouling is the accumulation of living organisms on artificial surfaces by adhesion, growth and reproduction (Cao et al., 2011). All vessels are subject to some level of marine biofouling. Surfaces commonly affected by biofouling on vessels include internal niches and areas subjected to low turbulence, such as seawater intakes and sea chests.

The RTM, which has been on location since 2006, may also be subject to some level of marine fouling. In February 2019, the RTM was inspected, and its marine growth sampled for IMS. Sampling of the RTM was undertaken in accordance with an IMS sampling procedure developed using sampling techniques and equipment advised by a suitably qualified and independent IMS inspector, selected in accordance with Woodside's IMS management procedures. Six samples, representing the depths of the length of the RTM, were sent to a qualified IMS assessment laboratory and analysed using quantitative polymerase chain reaction (qPCR) molecular testing to identify IMS of concern. The sampling did not detect any IMS of concern. The same qualified IMS inspector reviewed the video collected during sampling and the results of the laboratory testing and concluded that the inspection identified no evidence of IMS and that the RTM poses a low risk of IMS. In addition Woodside has applied the Woodside's IMS risk assessment process to activities undertaken in Operational Area 1 before ceasing operations and the risk of IMS establishing is remote. Given this, the RTM is not currently considered a potential source of IMS.

Establishment of IMS

NIMS pose a biosecurity risk if organisms are translocated from a donor location and establish a self-sustaining abundant population in a recipient location. For this to occur, organisms must be successful in passing through a series of stages:

- colonise a vessel (or other infrastructure) / present in ballast water from a donor location
- survive translocation from the donor to the recipient location
- adults, offspring and/or fragments transfer from the vessel to the surrounding recipient environment
- survive and colonise available substrata or habitat in the recipient location (i.e. the RTM)
- undergo ongoing reproduction in the recipient location to establish a viable population.

There is potential for significant natural attrition along the invasion pathway due to selective filters, resulting in a reduction in the total number of organisms that can survive and successfully transition to the next stage. These include, but are not limited to, the presence/absence and efficacy of antifouling coatings and marine growth prevention systems, residency periods in donor and recipient locations, voyage characteristics (e.g. speed, route and duration), environmental compatibility (e.g. water temperature, salinity), ballast water tank conditions (e.g. lack of light and physical water quality properties), extent of biofouling and associated number of IMS individuals (e.g. propagule pressure), organism fecundity and life history, water depth, current and wind conditions, distance to and availability of suitable habitat and predation pressures (Lewis and Coutts, 2010).

Notably, most species introduced to an area outside their natural range will not survive to establish or subsequently become invasive or a pest (Wells et al., 2009; Bax et al., 2003). Therefore, although there is a potential for NIMS to establish themselves in a foreign environment via ballast water and biofouling, not all IMS that enter Australian waters and are released into the marine environment are successful in establishing a population. For successful establishment to occur, a NIMS must first enter the ballast during water uptake and/or establish on a vector (e.g. hull), survive translocation from donor to recipient region, and then successfully be transferred, colonise and spread in the recipient environment to establish a new viable population. The likelihood of this series of stages occurring are considered remote given Woodside's and legislative requirements.

During the Petroleum Activities Program, project vessels and the MODU have the potential to introduce IMS to the environment within Operational Area 1 through biofouling (containing IMS), as well as ballast water exchange on vessels. There is a remote potential that there could be cross-contamination of IMS between project vessels/MODU that IMS could be transferred to the RTM during activities to prepare it for disconnection and removal (up to 30 days).

Impact Assessment

Potential impacts to environmental values

Potential IMS have historically been introduced and translocated around Australia by various natural and human means including biofouling and ballast water. Potential IMS vary from one region to another depending on various environmental factors (e.g. water temperature, salinity, nutrient levels, habitat type), which dictate their survival and invasive capabilities. IMS typically require hard substrate in the photic zone, and thus require shallow waters to become established. Highly disturbed, shallow-water environments such as shallow coastal waters, ports and marinas are more susceptible to IMS colonisation—IMS are generally unable to successfully establish in deepwater ecosystems and open-water environments where the rate of dilution and the degree of dispersal are high (Williamson and Fitter, 1996; Paulay et al., 2002; Geiling, 2014). Therefore, the undisturbed, deepwater, offshore location of Operational Area 1 is unlikely to represent suitable habitat for establishing IMS.

Once introduced, IMS may pose a considerable threat to the Australian marine environment, including commercial fisheries. IMS may prey on local species (which had previously not been subject to this kind of predation and therefore have not evolved protective measures), they may outcompete indigenous species for food, space or light, and can also interbreed with local species, creating hybrids such that the endemic species is lost. These changes to the local marine environment result in changes to the natural ecosystem.

IMS have also proven economically damaging to areas where they have been introduced and established. Such impacts include direct damage to assets (fouling of vessel hulls and infrastructure) and depletion of commercially harvested marine life (e.g. shellfish stocks). IMS have proven particularly difficult to eradicate from areas once established. If the introduction is detected early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life.

Despite the potential consequence of an IMS establishing within a high value environment as a result of introduction, the deep offshore open waters of Operational Area 1 (more than 12 nm from shore and in >400 m water depth) are not conducive to the settlement and establishment of IMS, unlike coastal or sheltered nearshore waters. IMS typically require hard substrate in the photic zone to become established; the only hard substrate in Operational Area 1 within the photic zone comprises the RTM, which has been inspected and sampled for IMS and is not considered to be a credible source of IMS. If IMS are transferred to the RTM from vessels, they may become established on the RTM while in its current location; however, it is not credible for them to become established within the wider Operational Area 1 given the water depths in this area.

Summary of Potential Impacts to Environmental Values(s)

To assess the impacts and risks of IMS introduction associated with the Petroleum Activities Program, Woodside conducted a risk and impact evaluation of the different aspects of a marine pest translocation. The results of this assessment are presented in **Table 6-15**.

As a result of this assessment, Woodside has assessed the highest potential consequence of slight, localised and temporary impacts to the environment, given the RTM will be removed from Operational Area 1 during the Petroleum Activities Program, and likelihood as remote, resulting in an overall low risk after identified controls are implemented. For evaluation of risks of IMS within Operational Area 2, refer to **Section 6.7.2.7**.

Table 6-15: Evaluation of risks and impacts from marine pest translocation

IMS Introduction Location	Credibility of Introduction	Consequence of Introduction	Likelihood
Introduced to Operational Area 1 and establish on the seafloor or subsea structures.	**Not Credible** The deep offshore open waters of Operational Area 1 are located away from shorelines (>30 km from a shore) and in waters >400 m deep; therefore, they are not conducive to the settlement and establishment of IMS.		
Introduced to Operational Area 1 and establish on a project vessel/MODU or the RTM.	**Credible** There is potential for the transfer of marine pests between project vessels/MODU or to the RTM while in its current location within Operational Area 1.	**Environment – Not credible** The translocation of IMS from a colonised MODU/project vessel to shallower environments via natural dispersion is not considered credible, given the distances of the Operational Area from nearshore environments (i.e. >12 nm and >50 m water depth). Therefore, there is no credible environmental risk and the assessment is limited to Woodside's reputation. **Reputation – D** If IMS were to establish on a project vessel (i.e. MODU, installation vessels, activity support vessels), this could potentially impact the vessel operationally by fouling intakes, resulting in translocation of an IMS into Operational Area 1 and, depending on the species, potentially transferring an IMS to other support vessels, the MODU or the RTM. If IMS were transferred to another support vessel/MODU, this would likely result in the quarantine of the vessel/MODU until eradication could occur (through cleaning and treating infected areas), which would be costly to perform. Such introduction would be expected to have minor impact on Woodside's reputation, particularly with Woodside's	**Remote (0)** Interactions between project vessels will be limited during the Petroleum Activities Program, with minimum 500 m safety exclusion zones in force around the MODU and RTM, and interactions limited to short periods alongside (i.e. during backloading, bunkering activities). There is also no direct contact (i.e. they are not tied up alongside) during these activities. Spread of marine pests via ballast water or spawning in the open ocean environment is also considered remote.

		contractors, and would likely have a reputational impact on future proposals. If IMS were transferred to the RTM there would be no impact to the environment as establishment of IMS would be restricted to the top portion of the RTM that is within the photic zone until it is disconnected and removed from its current location and from Operational Area 1. Therefore, there is no credible risk for IMS to become established within Operational Area 1 from establishment on the RTM. For evaluation of the risk of IMS becoming established from activities occurring within Operational Area 2 once the RTM has been towed outside Operational Area 1, refer to **Section 6.7.2.7**.	
Transfer between project vessels and by extension from project vessels to other marine environments beyond Operational Area 1 (i.e. transfer of IMS from offshore MODU, PIV to an activity support vessel and then to another environment).	**Not Credible** This risk is considered so remote that it is not credible for the purposes of the activity. The transfer of a marine pest between project vessels was already considered remote, given the offshore open ocean environment (i.e. transfer pathway discussed above). For a marine pest to then establish into a mature spawning population on the new project vessel (which would have been through Woodside's risk assessment process) and then transfer to another environment is not considered credible (i.e. beyond the Woodside risk matrix). Project vessels are located in an offshore, open ocean, deep environment, where IMS survival is implausible. Furthermore this marine pest once transferred would need to survive on a new vessel with good vessel hygiene (i.e. has been through Woodside's risk assessment process), and survive the transport back from Operational Area 1 to shore. If it was to survive this trip, it would then need to establish a viable population in nearshore waters.		

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Project vessels will manage their ballast water using one of the approved ballast water management options, as outlined in the Australian Ballast Water Management Requirements.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of transferring marine pests between project vessels within Operational Area 1. No change in consequence would occur.	Controls based on legislative requirements under the *Biosecurity Act 2015* – must be adopted.	Yes C 18.1

[36] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[36]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Good Practice				
Woodside's IMS risk assessment process[37] will be applied to the MODU, project vessels and relevant immersible equipment undertaking the Petroleum Activities Program. Assessment will consider these risk factors: For vessels/MODU: • vessel/MODU type • recent IMS inspection and cleaning history, including for internal niches • out-of-water period before 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 >7 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 treating internal	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 project vessels within Operational Area 1 is reduced. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes C 18.2

[37] Woodside's IMS risk assessment process was developed with regard to the national biofouling management guidelines for the petroleum production and exploration industry and guidelines for the control and management of a ships' biofouling to minimise the transfer of invasive aquatic species (IMO Guidelines, 2011).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.				
Restrict ballast water movement by the project vessels during subsea flushing and RTM tow preparations.	F: Yes. CS: Minimal cost. Good practice.	Reduces likelihood of transferring marine pests to the RTM within Operational Area 1. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes C 18.3
Professional Judgement – Eliminate				
No discharge of ballast water during the Petroleum Activities Program.	F: No. Ballast water discharges are critical for maintaining vessel stability. Given the nature of the Petroleum Activities Program, the use of ballast (including the potential discharge of ballast water) is considered to be a safety-critical requirement. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Eliminate use of MODU/vessels.	F: No. Given vessels must be used to implement the project, there is no feasible means to eliminate the source of risk. CS: Loss of the project.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
RTM inspected and tested for IMS of concern	F: Yes CS: Reasonable cost.	Given the recent inspection (February 2019) did not identify any evidence of IMS on the RTM, the RTM is not considered a potential source of IMS. It is not considered that further inspection will materially reduce the likelihood of IMS introduction.	Cost/sacrifice outweighs the benefit.	No
Professional Judgement – Substitute				
Source project vessels based in Australia only.	F: Potentially. Limiting activities to only use local project vessels could potentially pose a significant risk in terms of time and duration of sourcing a vessel, as well as the ability of the	Sourcing vessels from within Australia will reduce the likelihood of IMS from outside Australian waters; however, it does not reduce the likelihood of translocation of	Disproportionate. Sourcing vessels from Australian waters may result in a reduction in the likelihood of IMS introduction to Operational Area 1;	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	local vessels to perform the required tasks. For example there are limited primary installation vessels based in Australian waters. While the project will attempt to source support vessels locally, it is not always possible. Availability cannot always be guaranteed when considering competing oil and gas activities in the region. In addition, sourcing Australian based vessels only will cause increases in cost due to pressures of vessel availability. CS: Significant cost and schedule impacts due to restrictions of vessel hire opportunities.	species native to Australia but alien to Operational Area 1 and NWMR, or of IMS that have established elsewhere in Australia. The consequence is unchanged.	however, the potential cost of implementing this control is grossly disproportionate to the minor environmental gain (or reducing an already remote likelihood of IMS introduction) potentially achieved by using only Australian based vessels. Consequently, this risk is considered not reasonably practicable.	
IMS Inspection of all vessels.	F: Yes. Approach to inspect vessels could be a feasible option. CS: Significant cost and schedule impacts. In addition, the IMS risk assessment process (C 21.2) is seen to be more cost effective, as this control allows Woodside to manage the introduction of marine pests through biofouling, while targeting its efforts and resources to areas of greatest concern.	Inspection of all vessels for IMS would reduce the likelihood of IMS being introduced to Operational Area 1. However, this reduction is unlikely to be significant given the other control measures implemented. No change in consequence would occur.	Disproportionate. The cost outweighs the benefit gained, as other controls will be implemented to achieve an ALARP position.	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. 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, translocation of marine pests will not result in a potential impact greater than slight short-term impact on species or habitat within Operational Area 1. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of invasive marine species to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 18 No introduction and establishment of invasive marine species into the Operational Areas as a result of the Petroleum Activities Program.	**C 18.1** Project vessels will manage their ballast water using one of the approved ballast water management options, as outlined in the Australian Ballast Water Management Requirements.	**PS 18.1** Project vessels will manage ballast water in accordance with Australian Ballast Water Management Requirements.	**MC 18.1.1** Ballast Water Records System maintained by vessels which verifies compliance against Australian Ballast Water Management Requirements.
	C 18.2 Woodside's IMS risk assessment process[38] will be applied to project vessels and relevant immersible equipment undertaking the Petroleum Activities Program. Assessment will consider these risk factors: For vessels/MODU: • vessel/MODU type • recent IMS inspection and cleaning history, including for internal niches • out-of-water period before 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 >7 days • region of stationary or slow periods • type of activity – contact with seafloor. For immersible equipment:	**PS 18.2.1** Before entering the Operational Areas or IMS management area[39], project vessels, MODU and relevant immersible equipment are determined to be low risk[40] of introducing IMS of concern, and maintain this low risk status to mobilisation.	**MC 18.2.1** Records of IMS risk assessments maintained for all project vessels and relevant immersible equipment entering the operational area or IMS management area to undertake the Petroleum Activities Program.
		PS 18.2.1 In accordance with Woodside's IMS risk assessment process, the IMS risk assessments will be undertaken by an authorised environment adviser who has completed relevant Woodside IMS training or by qualified and experienced IMS inspector.	**MC 18.2.2** Records confirm that the IMS risk assessments undertaken by an Environment Adviser or IMS inspector (as relevant).

[38] Woodside's IMS risk assessment process was developed with regard to the national biofouling management guidelines for the petroleum production and exploration industry and guidelines for the control and management of a ships' biofouling to minimise the transfer of invasive aquatic species (IMO Guidelines, 2011).

[39] IMS management area is based on current legal framework and includes all nearshore waters around Australia, extending from the lowest astronomical tide mark to 12 nm from land (including Australian territorial islands). The IMS management area also includes all waters within 12 nm from the 50 m depth contour outside the 12 nm boundary (i.e. submerged reefs and atolls).

[40] Low risk of introducing IMS of concern is defined as either no additional management measures required or, management measures have been applied to reduce the risk.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• 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 treating internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.		
	C 18.3 Restrict ballast water movement by the project vessels during subsea flushing and RTM tow preparations.	**PS 18.1** Project vessels will restrict ballast water exchange during subsea flushing and RTM tow preparations.	**MC 18.1.1** Ballast Water Records System verifies ballast water exchange does not occur during subsea flushing and RTM tow preparations.

6.7 Impact and Risk Assessment for Activities within Operational Area 2

6.7.1 Planned Activities (Routine and Non-routine)

6.7.1.1 Physical Presence: Interactions with Other Marine Users during IAR Activities, as well as from the Long-term Presence of the IAR on the Seabed

Context		
RTM Activities – **Section 3.7** Project Vessels – **Section 3.10** Helicopters – **Section 3.12**	Socio-economic and Cultural Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

Impacts and Risks Evaluation Summary												
	Environmental Value Potentially Impacted							*Evaluation*				
Source of Impact	***Soil and Groundwater***	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Presence of project vessels causing interference with or displacement to third-party vessels (e.g. commercial shipping and commercial/recreational fishing/nature-based tourism operators) during activities within Operational Area 2							X	A	F	LCS GP PJ	Broadly acceptable	EPO 2, 3 and 19
Social amenity associated with increased recreational fishing opportunities							X	A	Beneficial Impact			
Economic benefit to regional stakeholders associated with increased recreational fishing							X	A	Beneficial Impact			
Proximity of helicopters causing interference with other aerial operations within Operational Area 1							X	A	F			

Description of Source of Impact	Description of Source of Impact

Presence of project vessels

Project vessels will be used to conduct the towing, placement, stabilisation and modification of the RTM (removal of risers and EHU, and injection of grout into compartment 13 to encapsulate the foam) as well as installation of reef modules to create an IAR. The project vessels will communicate with third-party vessels while conducting the activity and assist in maintaining an operational exclusion zone. Indicative project vessels, numbers, and timeframes for these activities are provided in **Table 6-16**. The RTM is about 85 m long and may be towed between 100 m and 500 m behind an AHT in a vertical position. The PIV and a second AHT will accompany the tow, and the three vessels will transit at 1–2.5 knots during the tow, depending on sea state conditions.

Table 6-16: Indicative durations of vessel-based activities during the Petroleum Activities Program

Activity	Vessels	Duration (days)*	Timing*
Towing	1 AHT (undertaking tow) 1 PIV and 1 AHT accompanying	Approximately 6–12 hours	Planned to occur between December 2020 and end April 2021
Placement, stabilisation and modification of RTM and installation of reef modules to create an IAR	1 PIV 2 AHT's	Approximately 15–20 days	

** Subject to suitable weather conditions, vessel availability and regulatory approvals*

Helicopters

During petroleum activities within Operational Area 2, crew changes may be undertaken using helicopters as required, but will not occur during towing of the RTM.

Long-term presence of IAR

Following these activities, the IAR will remain in place for 100–400 years and be available for use by all marine users, but will predominantly be used by recreational fishers and relevant tourism operators.

Impact Assessment

Potential impacts to environmental values

Presence of project vessels

During towing, placement, stabilisation, and modification of the RTM (removal of risers and injection of grout into compartment 13 to encapsulate the foam), and placement of the reef modules to create an IAR, the project vessels and the RTM may pose a navigational hazard to other marine users. Review of shipping fairways and AMSA vessel tracking data found that the tow route and proposed IAR location (Operational Area 2) do not overlap any shipping fairways, or areas of significant vessel activity (**Section 4.4.1**). Any vessel activity in Operational Area 2 is expected to be mainly associated with oil and gas activity in the area, similarly to for Operational Area 1.

Following consultation, AMSA requested notification before the activity commencing, and requested AHO also be notified four weeks before operations commencing. Commercial fishing activity in Operational Area 2 is expected to be consistent with that described in **Section 6.6.1.1** for Operational Area 1. Consultation with the commercial fishing sector identified no concerns or issues with the IAR location or activity. DPIRD Fish Cube data for the past five years of commercial fishing and charter operations found that up to three charter vessels operated in the area (60 × 60 nm block) in 2018–2019.

Given the proximity to shoreline (16 km off the North West Cape), and to the Ningaloo AMP, recreational fishers and nature-based tourism operators could be present in the 2 km radius IAR area, however there is no special features in the small area currently that would specifically draw people to the IAR area (**Section 4.5.5**). Three fishing tournaments were identified as potentially occurring within the December to April time period for the activities (**Section 4.5.5**). Consultation with the Exmouth Game Fishing Club who coordinate these tournaments, has expressed support for the IAR, did not raise any issues regarding timing for the proposed activity, and noted to Woodside that the Club had identified the location of the proposed reef through the stakeholder consultation process with Recfishwest on the reef permit (**Section 5**).

Given the short tow distance of the RTM (approximately 26 km) and duration over which the RTM will be towed (6–12 hours), and the small area within which activities will occur (approximately ~2 km radius for Operational Area 2) and short duration of activities that will occur in this area (15–20 days), and given that the tow route and proposed location for the IAR do not overlap any shipping fairways or areas of high shipping or fishing density, the impact to these users will be temporary with no negative lasting effect.

Vessels will not enter the Ningaloo AMP/WHP while conducting these activities, and, therefore, no impacts to the Ningaloo AMP and WHP will occur.

Interference with other aerial operations

Operational Area 2 is located within the northern tip of one of the designated defence practice areas of the Royal Australian Air Force base located at Learmonth (**Section 4.5.7**). Although it is unlikely that helicopter activities from the petroleum activity program could interfere with defence activities, using helicopters to transfer crew has the potential to interact with defence activities, and therefore defence stakeholders were consulted (**Section 5**). No concerns were raised during the consultation process, and as such the potential impact is considered to be of no lasting effect.

Long-term presence of IAR – Location Selection

The proposed integrated artificial reef location has been identified based on consultation by Recfishwest with the recreational fishing community in Exmouth, and a constraints mapping process. The constraints mapping process was undertaken to ensure that the proposed location is compatible with the purpose of the artificial reef, and includes considered feedback from the local recreational fishing community, as well as avoidance of marine parks, shipping, anchorages and channels and areas for defence activities. The key constraints for selection of a suitable location were:

- outside State and Commonwealth marine parks
- outside State and Commonwealth petroleum titles
- minimum 80 m water depth (due to RTM being towed in a vertical position)
- maximum 200 m water depths.

Feedback from the Recfishwest consultation process (**Section 5**) unanimously supported the proposed location based on site accessibility, water depth and access to fishing opportunities, specifically:

- proximity to the mainland (site is accessible from both Bundegi and Tantabiddi boat ramps (~23 km and ~28 km transits respectively)
- prevailing winds allowing for a safer and more comfortable journey to and from the artificial reef site
- water depth is still accessible for most conventional fishing gear (up to 250 m for line fishing)
- location in and around the greater billfish fishing grounds
- location near the proposed location of future fish aggregation devices
- desired fish recreational species

Long-term presence of IAR – Design

Recfishwest, along with engineering reef specialist Subcon have designed the IAR to create ecological productivity as a result of surface area, shelter, interstitial spaces, upwelling, connectivity and the reef halo effect, along with a suitable location for fishing

The RTM size and shape has a high habitat value if repurposed to create an artificial reef, with some limitations. The RTM will provide habitat features such as ledges, and shelter due to its varying shape and tapers. Its length and high vertical profile even in a horizontal position, mean it will modify currents creating turbulent flows and upwelling when on the seabed, and it will provide a large surface area (>1800 m^2) for colonising by complex epi-benthic habitat. The limitations are the cylindrical shape, with relatively few external features and opening. The RTM therefore has different features to create a habitat for multi-species diversity, however, it can be improved using purpose-built reef modules to create an IAR design that will meet an intended artificial reef purpose.

The IAR design is based on learnings from other artificial reef designs from around Australia, and will includes clusters of reef modules of two sizes similar to purpose-built reefs at Shoalhaven, Port Macquarie, Port Hacking and Hervey Bay. The module spacing within clusters is based on the Shoalhaven reef, which has shown to be an effective size and cluster combination. Large reef modules have been chosen as each provide 80 m^3 of habitat value and are shown to support approximately six times the biomass compared to natural sites. The smaller reef modules are specifically designed for juvenile fish and reef associated species like Grouper and Red Emperor.

The IAR has been designed to provide productivity and a suitable fishing location. Proximity of modules ensures ecological productivity through connectivity, and the module types create a variation of habitat and will enable a variation in hydrological aspects. The overall numbers and size will enable fishers to be able to find and effectively use the reef. The detailed design is aimed at productivity resulting from connectivity, halo effect, surface area, area of influence of the IAR, interstitial spaces and juvenile fish maturation based on studies from existing artificial reefs (Barros, Underwood, and Lindegarth, 2001; Lennon, 2011; Smith et al., 2017; Florisson et al., 2018; Reeds et al., 2018; Becker et al., 2019). Reef connectivity means the whole is greater than the sum of the parts. The overlapping habitats result in species richness and biomass. This is called “ecotone” (Dorenbosch et al., 2005; Connolly and Hindell, 2006; Smith et al., 2008).

The integrated artificial reef creates its own unique ecosystem which has a higher species diversity, abundance and biomass than natural sites, and higher numbers of target species than natural systems.

The depth at ~150 m requires a large footprint (>100 m x 100 m). The proposed size is typical of many artificial reefs around Australia including Mandurah, Exmouth, Shoalhaven, Busselton and Bunbury reefs, and all structures proposed for the IAR will provide sufficient vertical profile (>1.5 m) to appear on sounders. The IAR also provides a large target for drop line fishers when the current carries their gear horizontally offset below their boats. The large footprint will allow fishers to locate the IAR and target gear onto it. It will also allow more boats to fish the IAR system. The design is engineered to enable a productive ecosystem to become established and provide high quality fishing experiences for the community of Exmouth and its visitors.

Long-term presence of IAR – Beneficial Impacts

As a result of the IAR location selection and design described above, the IAR is expected to deliver a number of social and economic benefits to Exmouth and the broader Gascoyne region.

The proposed IAR design and location will create an opportunity for boat-based, inshore (20–250 m depth) demersal line fishing (see **Section 4.5.5**), consistent with the recreational boat fishing that occurs in the region (Ryan et al., 2016). The IAR is also expected to provide an opportunity for pelagic fishing, particularly for species such as amberjack and billfish. The IAR would provide a suitable recreational fishing location for fishers and during game fishing tournaments.

The Gascoyne region experiences the second highest recreational fishing effort in the State (12%), after the West Coast Bioregion (74%) which is around Perth and the regional cities of Bunbury, Busselton and Geraldton (Tate et al., 2020). The Exmouth region hosts a variety of fishing events such as GAMEX, the Billfish Bonanza, and the Australian Junior Billfish Tournament, which result in increased fishing activity in the area (**Section 4.5.5**).

Recreational fishing plays a valuable role in maintaining physical health, mental health, and general well-being; enabling people to be active, relax, and socially bond with family and friends. Recreational fishers also generally have a strong sense of connection and stewardship for the marine environment which helps building a sense of community.

Engagement with the Exmouth Game Fishing Club, WA Game Fishing Association, Shire of Exmouth, and the ECCI, who represent a number of charter operators, has shown support for the IAR (**Section 5**).

Recreational fishers in the Gascoyne region spend AU$27.5 million per year, driven by a high percentage of boat-based fishing, with almost half of all fishers in the region regularly or solely fishing from a boat. Almost half of fishers in the region fish more than 20 days per annum, which is a higher percentage than any other region in the State. The Shire of Exmouth generates the greatest tourist expenditure of all Shires within the Gascoyne region, with marine-based experiences including recreational fishing and fishing charters a key attraction for tourists.

In addition to the direct social benefit to user groups including recreational fishers, charter operators and potentially commercial fishers, broader social and economic benefits are expected from the artificial reef in Exmouth including:

- Coastal resorts and tourism facilities that base their developments around the demand generated by quality recreational marine experiences
- Tourism and charter (fishing or diving) operators who base their businesses around the quality of the fishing experience and the abundance of fish
- Tackle and boating industry that depend on having sustainable fish resources along the Pilbara Coast
- Goods and service providers (hospitality/fuel)
- Local services used to support scientific monitoring of reef

If the IAR is left in place permanently, it will provide a reef for a minimum of 100 years, based on the degradation estimates for the RTM structure and concrete reef modules (see **Section 6.7.1.3**).

Summary of potential impacts to environmental values(s)

Given the adopted controls, it is considered that the physical presence of project vessels and the RTM will not result in a potential impact greater than localised temporary displacement of shipping, commercial/recreational fishing, nature-based tourism operators, oil and gas interests with a consequence of no lasting negative effect. Vessel-based activities will lead to a negligible increase in the overall vessel traffic in Operational Area 2 and no cumulative impacts from the interference with or displacement of third party vessels are expected.

The long-term presence of the IAR will result in a beneficial impact to recreational fishers, tourism operators and other regional stakeholders for a significant duration (100–400 years) and no long-term negative impacts to commercial fisheries or shipping activity.

Demonstration of ALARP

Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[41]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Legislation, Codes and Standards (other than OPGGS Act)				
Approval of artificial reef permit under the Sea Dumping Act 1981, which ensures the following (DAWE, 2008): • an appropriate site has been selected • the materials are suitable and prepared properly • no significant adverse impact on the marine environment occurs • the reef does not pose a danger to navigation, fisherman or divers • the artificial reef is charted on maritime maps.	F: Yes CS: Minimal cost. Standard practice.	Artificial reef permit application process ensures that the proposal for the IAR is environmentally acceptable and that the IAR will serve a purpose (DAWE, 2008).	Control based on legislative requirements – must be adopted.	Yes 19.1

[41] Qualitative measure

Ongoing, regular surveys of the IAR	F: Yes. CS: Moderate cost.	Long term monitoring of the IAR will be performed by Recfishwest, as required under the artificial reef permit. This is described in **Section 7.5.4**.	Control based on legislative requirements – must be adopted.	Yes 19.2
Good Practice				
500 m operational exclusion zone established around RTM during towing, placement, stabilisation and augmentation of the RTM as an IAR.	F: Yes CS: Minimal cost. Standard practice.	Communicating the activities to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Control is good practice.	Yes 2.1b
Activity support vessel(s) on standby during towing and placement, of the RTM at IAR site to assist in maintaining the operational exclusion zone.	F: Yes CS: Minimal cost. Standard practice.	Maintaining the operational exclusion zone reduces the likelihood of interfering with other marine users.	Control is good practice.	Yes 2.2b
Design tow route to minimise interactions with other marine users.	F: Yes CS: Minimal cost. Standard practice.	Designing the tow route to avoid areas of known marine traffic will reduce the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice.	Yes 2.4
Retain navigation lights on RTM if towing outside daylight hours	F: ROV removable navigation lights have been installed on the RTM to allow lights to be left on the RTM during tow and removed once RTM is on the seabed. CS: Moderate cost	If RTM is to be towed during daylight period, there is no benefit associated with retaining navigation lights, and navigation lights may be removed before tow, given the short duration. If RTM is to be towed outside daylight hours, there is a navigation benefit associated with retaining light and lights will be left in place. The lights will be removed from the RTM before it is left in place as an IAR.	Benefits outweigh cost/sacrifice	Yes 2.5
IAR will be marked on navigational charts.	F: Yes CS: Minimal cost. Standard practice.	Marking the IAR on navigation changes ensures other users are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Control based on legislative requirements – must be adopted.	Yes 2.6

AHO notified of activity no less than four working weeks before undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Notification to AHO will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notices to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Control is Standard Practice.	Yes 3.1
DPIRD notified of activities within three months of undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes 3.2
AMSA notified JRCC of activities 24–48 hours of undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes 3.3
Consultation undertaken with relevant stakeholders for activities within the Petroleum Activities Program that commence more than a year after EP acceptance.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes 3.4
DMIRS will be notified of the final location of the IAR once IAR activities are completed	F: Yes. CS: Minimal cost.	Providing the final location of the IAR to DMIRS ensures they are informed and aware, and can provide this information to other marine users, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice.	Yes 3.6
DoD will be notified a minimum of five weeks prior to undertaking activities within the Petroleum Activity Program.	F: Yes. CS: Minimal cost.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice.	Yes 3.7

Location of IAR selected based on: • water depth (not a navigation hazard) • avoidance of shipping lanes • suitability for deepwater fishing • accessible location from existing boat ramps	F: Yes CS: Moderate cost	Locating the IAR based on water depth, avoidance of sensitive areas, avoidance of shipping and suitability for deepwater fishing will ensure that the IAR will not become a navigational hazard. It is likely that the RTM structure will provide artificial habitat value (i.e. achieve a purpose) without augmentation, however addition of supporting reef towers is likely to accelerate and further enhance the benefit.	Benefits outweigh cost/sacrifice	Yes 20.1
Augmentation of the RTM structure through installation of purpose-built reef modules	F: Yes CS: Moderate cost	It is likely that the RTM structure will provide artificial habitat value (i.e. achieve a purpose) without augmentation, however addition of supporting reef modules will better achieve its purpose as an artificial reef for recreational fishing.	Benefits outweigh cost/sacrifice	Yes 20.2
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of the presence of the RTM and project vessels on other users, such as commercial fisheries, recreational fishing, oil and gas operators, and shipping. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, the presence of the project vessels on other users represents a consequence to commercial fishing, recreational fishing, defence, and shipping activities within the Operational Area limited to no lasting effect. The tow route and IAR location do not overlap any shipping fairways, or areas of significant vessel 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 requirements of the Sea Dumping Act, Australian Marine Orders, and expectations of stakeholders (including AMSA and AHO) determined during consultation. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of presence of the project vessels and the RTM on other users to a level that is broadly acceptable. There is an additional social amenity benefit to recreational fishers and economic benefit to recreational fishing industry and tourism operators from the long-term presence of the IAR. This benefit has been confirmed through

consultation with relevant local stakeholders during the IAR site selection process. These beneficial impacts have been considered in demonstrating an equal or better environmental outcome for the IAR in **Section 3.6.3.3**.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 Prevent adverse interactions between vessels/RTM and other marine users during the Petroleum Activities Program.	**C 2.1b** 500 m operational exclusion zone established around RTM during towing, placement, stabilisation and augmentation of the RTM as an IAR.	**PS 2.1b** No adverse interactions between vessels/RTM.	**MC 2.1.1b** Records of adverse interactions in 500 m operational exclusion zone with other marine users are recorded.
	C 2.2b Activity support vessel(s) on standby during towing and placement of the RTM at the IAR site to assist in maintaining the operational exclusion zone.	**PS 2.2b** Activity support vessel(s) on standby during towing and placement activities to assist in maintaining the operational exclusion zone to prevent unplanned interaction and assist in emergencies as required.	**MC 2.2.1a** Records demonstrate activity support vessel(s) present during towing, and placement of the RTM on the seabed.
	C 2.4 Design tow route to minimise interactions with other marine users.	**PS 2.4** Tow route designed to avoid where practicable areas frequented by other marine users such as commercial shipping lanes.	**MC 2.4.1** Records demonstrate tow route optimised for minimal interaction with other marine users.
	C 2.5 Retain navigation lights on RTM if towing outside daylight hours.	**PS 2.5** Contractor procedures to state RTM navigation lights to remain on RTM for towing outside daylight hours.	**MC 2.5.1** Records demonstrate navigation lights left on RTM for towing outside daylight hours.
EPO 3 Marine users aware of the Petroleum Activities Program.	**C 3.1** Refer to **Section 6.6.1.1**.	**PS 3.1** Refer to **Section 6.6.1.1**.	**MC 3.1.1** Refer to **Section 6.6.1.1**.
	C 3.2 Refer to **Section 6.6.1.1**.	**PS 3.2** Refer to **Section 6.6.1.1**.	**MC 3.2.1** Refer to **Section 6.6.1.1**.
	C 3.3 Refer to **Section 6.6.1.1**.	**PS 3.3** Refer to **Section 6.6.1.1**.	**MC 3.3.1** Refer to **Section 6.6.1.1**.
	C 3.4 Refer to **Section 6.6.1.1**.	**PS 3.4** Refer to **Section 6.6.1.1**.	**MC 3.4.1** Refer to **Section 6.6.1.1**.
	C 3.6 DMIRS will be notified of the final location of the IAR once IAR activities are completed.	**PS 3.6** Final location of IAR provided to DMIRS following IAR activities.	**MC 3.6.1** Consultation records demonstrate DMIRS have been provided final location of IAR.
	C 3.7 DoD will be notified a minimum of five weeks prior to undertaking activities within the Petroleum Activity Program.	**PS 3.7** Notification to DoD to reduce activities interfering with planned defence activities.	**MC 3.7.1** Consultation records demonstrate DoD has been notified prior to undertaking activities

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
			within required timeframes.
EPO 19 Repurposing of the RTM as an IAR will comply with the requirements of the Sea Dumping (Environmental Protection) Act 1981.	**C 19.1** Approval of an artificial reef permit under the Sea Dumping Act 1981, which ensures the following (DAWE, 2008): • an appropriate site has been selected • the materials are suitable and prepared properly • no significant adverse impact on the marine environment occurs • the reef does not pose a danger to navigation, fisherman or divers • the artificial reef is charted on maritime maps.	**PS 19.1** The RTM will meet the requirements of the Sea Dumping Act for repurposing as an IAR.	**MC 19.1.1** An accepted artificial reef permit for repurposing of the RTM as an IAR.
	C 19.2 Ongoing, regular surveys of the IAR	**PS 19.2** Requirements for long-term monitoring of the IAR included as part of the artificial reef permit.	**MC 19.2.1** Accepted artificial reef permit.
			MC 19.2.2 Contract between Recfishwest and Woodside to undertake long-term monitoring of the IAR
EPO 20 IAR provides a social amenity benefit to recreational fishers and economic benefit to region[42].	**C 20.1** Location of IAR selected based on: • water depth (not a navigation hazard) • avoidance of shipping lanes • suitability for deepwater fishing • accessible location from existing boat ramps	**PS 20.1** IAR installed in location as described in **Section 3.7.4**	**MC 20.1.1** Records demonstrate RTM and concrete reef modules installed in approved location.
	C 20.2 IAR designed to create high value habitat suitable for creation of artificial reef, including hard substrate associa ted with RTM along with purpose-built reef modules.	**PS 20.2** RTM and concrete reef modules installed in location as described in section xxx.	**MC 20.2.1** Records demonstrate RTM and concrete reef modules installed in approved location.

[42] Once installed to design specifications outlined in the artificial reef permit, ownership of the IAR will transfer to the WA State Government (DPIRD) under monitoring and management by Recfishwest (**Section 1.10.1.3**). In the unlikely event that adaptive management is required, this will be undertaken under by the State/Recfishwest with oversight from DAWE. **Section 7.5.4** outlines long-term monitoring commitments which will be commited to as part of the artificial reef permit.

6.7.1.2 Physical Presence: Disturbance to Seabed during IAR Activities, as well as from the Long-term Presence of the IAR on the Seabed

Context	
RTM Activities – **Section 3.7**	Physical environment – **Section 4.3** Biological environment – **Section 4.4**

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-economic*	*Decision Type*	*Consequence*	*ALARP Tools*	*Acceptability*	*Outcome*
Disturbance to benthic habitat from placement, stabilisation and modification of the RTM (including grouting of foam and bend stiffeners) and installation of reef modules.		X	X		X			A	F	LCS GP PJ	Broadly acceptable	EPO 5 and 19
Disturbance to benthic habitat from long-term physical presence of IAR.		X	X		X			A	F			
Increase in hard substrate with habitat value as a result of long-term physical presence of RTM and concrete reef modules.					X				Beneficial Impact			

Description of Source of Impact

Placement, stabilisation and modification of the RTM

Following towing of the RTM to the proposed location of the IAR, it will be lowered in a controlled manner onto the seabed at the proposed IAR location (**Section 3.7.4**). The RTM is approximately 85 m long and will result in an approximately 700 m^2 area of seabed disturbance within this square block.

Once the RTM is on the seabed, the risers and EHU will be removed by pulling each riser/EHU horizontally out the top of the RTM using pre-installed ROV connectable rigging. As the risers and EHU are being pulled they will potentially be dragged along the seabed for approximately 100 m (approximately the length of the risers/EHU) until they are fully outside the structure and can be lifted to the surface.

The bend stiffeners will be initially cut from the RTM while in its current location within Operational Area 1 (**Section 3.7.4**). If any plastic remains following this cut, a second cut will be attempted via ROV following placement of RTM on the seabed at the proposed IAR location. If any plastic from the bend stiffeners is unable to be cut from the RTM, the plastic will be encapsulated in grout. If any of the bend stiffeners end up below the sediment line (i.e. RTM will be in a horizontal position on the seabed), an ROV will be used to dredge a small area at the bottom of the RTM to remove the sediment and allow the cut and removal or grouting to be undertaken.

Following placement of the RTM on the seabed, approximately 24 large purpose-built concrete modules (around 4 m x 4 m x 5 m in size) and 24 small modules (around 2.1 m round x 1.8 m high in size) will be installed around the RTM using an installation vessel. The total seabed disturbance associated with the concrete modules is approximately 470 m^2. The total area of seabed disturbance for the IAR is estimated at approximately 1170 m^2; this area will be contained within a maximum 300 m by 300 m area within the defined 500 m radius around the proposed IAR location centre point (**Section 3.7.4**).

A detailed hydrodynamic analysis of the RTM structure and reef modules was undertaken to ensure stability of the structures once they are on the seafloor. Typically, a 1 in 100 year storm event is used to design the stability of an artificial reef. In this instance, a 1 in 10,000 year cyclonic wave event was analysed to determine the stability against storm wave forces at the water depth of the RTM and reef modules. Loads were then calculated on the structures, based on their shape, resulting drag, and added mass coefficients. In this analysis, the RTM structure was considered as a pipeline and industry standard coefficients for a pipeline were used. The reef modules were analysed based on their engineered shapes and specific design criteria supplied by the structure manufacturer.

The calculated forces on the reef were used to perform two stability checks. The first stability check considered the structures' resistance to sliding. The frictional forces between the RTM or reef module and the seabed generated by its own self-weight were compared to the storm forces trying to slide the structures.

If the frictional forces from the self-weight exceed the environmental forces from the expected wave forces from a 1 in 10,000 year storm event, the structure is stable. Part of design for stability of the IAR includes a safety factor of 2, meaning the structures will withstand double the maximum wave force expected in a 1 in 10,000 year storm before being at risk of sliding.

The second stability criteria considered overturning (or rolling), where overturning produced by the environmental forces on the RTM or reef modules was compared to the 'righting' movement produced by the self-weight of the structures. If the self-weight of the structure is large enough, the structure will not move.

The RTM and reef modules have been designed to meet both stability criteria so that once ballasted on the seafloor the RTM won't slide or roll. The stability of the structures will be monitored during the life of the artificial reef and managed in accordance with the LTMP (**Section 7.5.4**).

Long-term Physical Presence of IAR

IAR location and design are described in **Sections 3.7.4** and **6.7.1.2**. Once deployed, the IAR will result in current changes due to physical presence of the structures that the currents will be forced to move around. These will create changes in sediment distribution around the IAR.

Impact Assessment

Potential impacts to environmental values

Ecosystems / Habitats and Marine Sediment

Benthic surveys conducted as part of the artificial reef permit application process have found the area around the proposed location of the IAR to be relatively featureless, and comprise soft sediments with low density epibiota (**Section 4.4.1**). These soft sediment habitats, and associated biological communities, are widely represented throughout the NWMR and are not considered to be of particular conservation significance. The area does not overlap any sensitive or protected habitat. The surveys did not detect any hard substrates or hard coral dominated communities. The nearest hard coral communities (e.g. Helby Banks) are located in water depths <40 m, at least 11 km distance away from proposed location of the IAR (**Section 4.4.2.2**). Vessels will not traverse outside Operational Area 2 during the activities, and, therefore, no impacts to the benthic habitats within the Ningaloo AMP and WHP will occur.

As the RTM does not contain any significant quantities of contaminants (e.g. the risers have been flushed), the disturbance to the seabed will be limited to localised smothering of habitats and sediment with negligible impact. Long-term degradation of the IAR components is described in **Section 6.7.1.3**. Disturbance to benthic habitats and seabed is expected to be confined to the defined area of the IAR as it has been designed to a 1 in 10,000 year cyclonic wave event.

The long-term presence of the IAR will create small changes in sediment movement, however, this will be localised to the IAR's location and result in negligible impact to benthic communities. The IAR is designed to create ecological productivity as a result of surface area, shelter, interstitial spaces, upwelling, connectivity and the reef halo effect, along with a suitable location for fishing. This has the additional environmental benefit of reducing fishing pressure in other locations

Water Quality

During placement of the RTM and reef modules, pulling of the risers/EHU and potential ROV dredging to allow the bend stiffeners to be grouted, there will be temporary and localised increases in turbidity within the proposed location for the IAR, with no lasting effect. The plume created is not expected to extend beyond Operational Area 2, and, therefore, no impacts to the Ningaloo AMP and WHP will occur.

Summary of potential impacts to environmental values(s)

Given the adopted controls, seabed disturbance from placement, stabilisation and modification of the RTM as an IAR as well as installation of reef modules will be limited to localised and negligible impacts to benthic habitats, marine sediment and water quality within Operational Area 2. The long-term disturbance to seabed within the 1170 m^2 area where the IAR will be placed will have negligible impacts to widely represented benthic habitats and the IAR will provide a net benefit to the environment as it will provide an increase in hard substrate that is not otherwise available within the area.

In addition, there is a beneficial impact associated with the installation the RTM and concrete reef modules, increasing hard substrate and with high habitat value suitable for creation of an artificial reef. Presence of an artificial reef has potential to benefit the broader environment by providing a targeted fishing location, and reducing fishing pressures in other areas.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[43]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Approval of a artificial reef permit under the Sea Dumping Act 1981, which ensures the following (DAWE, 2008): • an appropriate site has been selected • the materials are suitable and prepared properly • no significant adverse impact on the marine environment occurs • the reef does not pose a danger to navigation, fisherman or divers • the artificial reef is charted on maritime maps.	F: Yes CS: Minimal cost. Standard practice.	Artificial reef permit application process ensures that the proposal for the IAR is environmentally acceptable and that the IAR will serve a purpose (DAWE, 2008).	Control based on legislative requirements – must be adopted.	Yes 19.1
Ongoing, regular surveys of the IAR	F: Yes. CS: Moderate cost.	Long term monitoring of the IAR will be performed by Recfishwest, as required under the artificial reef permit. This is described in **Section 7.5.4**.	Control based on legislative requirements – must be adopted.	Yes 19.2
Good Practice				
Laydown of RTM and reef modules in pre-defined area to limit the extent of disturbance to the seabed.	F: Yes CS: Standard activity, no significant additional cost associated with activity.	Placement of the RTM and reef modules onto the seabed will be monitored using location beacons on the ROV, crane hook and RTM to confirm through the PIV's navigation system that the RTM and reef modules are in the correct positions before landing thereby significantly reducing the likelihood of placement outside the defined area. Following landing all structure locations will be confirmed and coordinates recorded.	Benefits outweigh cost/sacrifice	Yes C 5.3b
Operational Area 2 designed to avoid any impacts to benthic habitat within	F: Yes CS: minimal cost.	Implementation of Operational Area 2 proximity and alarm buffers reduces the likelihood of seabed	Benefits outweigh cost/sacrifice	Yes C 5.4

[43] Qualitative measure

Ningaloo WHP and AMP, including: • buffer zone adjacent to boundary of Ningaloo WHP and AMP, which comprises a buffer zone commencing at 280 m from boundary to make vessels aware that they are approaching boundary and buffer alarm zone commencing at 100 m from the boundary to alert vessels to not transit further towards Ningaloo WHP and AMP.		disturbance within the Ningaloo AMP and WHP.		
Controlled sinking of the RTM through ballasting operations to limit the extent of disturbance to the seabed.	F: Yes CS: Minimal Cost	Controlled sinking of the RTM will ensure that the RTM reaches the seabed at a low velocity to minimise seabed disturbance	Benefits outweigh cost/ sacrifice.	Yes C 5.5
Controlled lowering of concrete modules to limit the extent of disturbance to the seabed.	F: Yes CS: Minimal Cost	Controlled placement of the modules will ensure they are placed on seabed at a low velocity to minimise disturbance.	Benefits outweigh cost/ sacrifice.	Yes C 5.6
No anchoring of vessels in Operational Area 2 to limit the extent of disturbance to the seabed.	F: Yes (use DP) CS: Minimal Cost	Use of DP system to control position rather than anchoring will minimise seabed disturbance.	Benefits outweigh cost/ sacrifice.	Yes C 5.7
Create habitat value at IAR location	F: Yes CS: Moderate	Designing reef to allow the creation of value habitat will allow IAR to provide suitable habitat for many species, that is otherwise not available	Benefits outweigh cost/ sacrifice.	Yes C 21.1
Professional Judgement – Eliminate				
Do not use ROV close to, or on, the seabed.	F: No. Using ROVs (including work close to or occasionally landed on the seabed) is critical as the ROV is the main tool used to guide and manipulate equipment during activities. ROV usage is already limited to only that required to conduct the work effectively and safely. Due to visibility and operational issues ROV work on or close to the seabed is avoided unless necessary.	Not considered – control not feasible	Not considered – control not feasible	No

	CS: Not considered – control not feasible			

Professional Judgement – Substitute

No additional controls identified.

Professional Judgement – Engineered Solution

No additional controls identified.

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of disturbance to the seabed from placement, stabilisation and augmentation of the RTM as an IAR. As no reasonable additional/alternative controls were identified that would further reduce the impacts without disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, disturbance to the seabed from placement, stabilisation and augmentation of the RTM as an IAR represents a consequence to benthic habitat, marine sediment and water quality limited to no lasting effect. 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 Woodside's relevant systems and procedures. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance to a level that is broadly acceptable.

There is an additional environment benefit from the long-term presence of the IAR providing increase ecological productivity and reduced fishing pressure on natural areas. These beneficial impacts have been considered in demonstrating an equal or better environmental outcome for the IAR in **Section 3.6.3.3**.

Environmental Performance Outcomes, Standards and Measurement Criteria

Outcomes	*Controls*	*Standards*	*Measurement Criteria*
EPO 5 No impacts to benthic habitats greater than a consequence level of F[44].	**C 5.3b** Laydown of RTM and reef modules in pre-defined area to limit the extent of disturbance to the seabed.	**PS 5.3b** Placement of RTM and reef modules limited to within 300 m by 300 m block to limit the extent of disturbance to the seabed.	**MC 5.3b.1** An 'as left survey' will be undertaken as part of the artificial reef permit to verify that IAR deployment is within 300 m by 300 m block within the 500 m radius defined IAR location.
	C 5.4 Operational Area 2 designed to avoid any impacts to benthic habitat within Ningaloo WHP and AMP, including:	**PS 5.4** Buffer zone and buffer alarm zone implemented during operations.	**MC 5.4.1** Records demonstrate compliance with buffer zone and buffer alarm zone.

[44] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• buffer zone adjacent to boundary of Ningaloo WHP and AMP, which comprises a buffer zone commencing at 280 m from boundary to make vessels aware that they are approaching boundary and buffer alarm zone commencing at 100 m from the boundary to alert vessels to not transit further towards Ningaloo WHP and AMP.		
	C 5.5 Controlled sinking of the RTM through ballasting operations to limit the extent of disturbance to the seabed.	**PS 5.5** Contractor procedures required RTM to be sunk through controlled ballasting.	**MC 5.5.1** Records demonstrate RTM sunk using controlled ballasting procedure.
	C 5.6 Controlled lowering of concrete modules to limit the extent of disturbance to the seabed.	**PS 5.6** Contractor procedures to require controlled lowering of concrete modules.	**MC 5.6.1** Records demonstrate compliance with procedures.
	C 5.7 No anchoring of vessels in Operational Area 2 to limit the extent of disturbance to the seabed.	**PS 5.7** Contractor procedures to include requirement for no anchoring.	**MC 5.7.1** Records demonstrate compliance with procedures.
EPO 19 Repurposing of the RTM as an IAR will comply with the requirements of the Sea Dumping (Environmental Protection) Act 1981.	**C 19.1** Refer to **Section 6.7.1.1**.	**PS 19.1** Refer to **Section 6.7.1.1**.	**MC 19.1.1** Refer to **Section 6.7.1.1**.
	C 19.2 Refer to **Section 6.7.1.1**.	**PS 19.2** Refer to **Section 6.7.1.1**.	**MC 19.2.1** Refer to **Section 6.7.1.1**.
			MC 19.2.2 Refer to **Section 6.7.1.1**.
EPO 21 Create habitat value at IAR location[45].	**C 21.1** IAR designed to create value habitat (**Section 3**) suitable for creation of artificial reef, including hard substrate associated with RTM along with purpose-built reef modules.	**PS 21.1** RTM and concrete reef modules installed in location as described in **Section 3**.	**MC 21.1.1** Records demonstrate RTM and concrete reef modules installed in approved location.

[45] Once installed to design specifications outlined in the artificial reef permit, ownership of the IAR will transfer to the WA State Government (DPIRD) under monitoring and management by Recfishwest (**Section 1.10.1.3**). In the unlikely event that adaptive management is required, this will be undertaken under by the State/Recfishwest with oversight from DAWE. **Section 7.5.4** outlines long-term monitoring commitments which will be commited to as part of the artificial reef permit.

6.7.1.3 Routine and Non-routine Discharges: Long-term Degradation and Corrosion of the RTM and Reef Modules

Context	
RTM Activities – **Section 3.7**	Physical environment – **Section 4.3** Biological environment – **Section 4.4**

Impacts and Risks Evaluation Summary												
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Long-term corrosion and breakdown of the RTM left in place		X						A	F	LCS GP PJ	Broadly acceptable	EPO
Long-term breakdown and release of the RTM coating system (epoxy and paint)		X						A	F			
Discharge of hydraulic fluid as RTM left in place breaks down			X					A	F			
Long-term release of iron ore as RTM left in place breaks down		X						A	F			
Long-term degradation of the concrete reef modules and concrete within the RTM		X						A	F			

Description of Source of Impact

A description of the RTM and activities planned to be undertaken to prepare it to become an IAR are described in **Section 3.7**. As part of these activities, the risers and bend stiffeners are planned to be removed, and any remaining plastics encapsulated in grout, the degradation of these plastics are not planned, and are considered an unplanned release. As such, these are described in **Section 6.7.2.1**, as an unplanned risk.

Corrosion and breakdown of the RTM left in-situ

The RTM was fabricated from structural steel specified to Lloyds 36 grade carbon steel (**Table 6-19**). It has varying wall thickness of between 20 mm and 50 mm, with a total mass of approximately 1422 tonnes of steel. Once installed as part of an IAR, over time the RTM structure will corrode and release degradation materials; predominantly iron (>98%), but also other trace materials (**Table 6-19**) into the water column and surrounding sediments.

Table 6-17: Composition of Lloyds 36-grade carbon steel

Component	***Percentage (%)***
Carbon (C)	≤ 0.16
Manganese (Mn)	0.7 – 1.6
Silicon (Si)	0.1 – 0.5
Sulfur (S)	≤ 0.025
Phosphorous (P)	≤ 0.025
Nickle (Ni)	≤ 0.8

Chromium (Cr)	≤ 0.25
Molybdenum (Mo)	≤ 0.08
Copper (Cu)	≤ 0.35
Niobium (Nb)	≤ 0.05
Vanadium (V)	≤ 0.1

Note: Iron (Fe) is the balance.

The external surface of the RTM has been installed with an anti-corrosion coating system (epoxy and paint overcoats) as the primary system of corrosion control. The coating system prevents contact between the steel and oxygenated seawater, thereby preventing corrosion by oxidisation. A cathodic protection system (aluminium sacrificial anodes) has also been installed to provide protection for any imperfections in the external coating system. These imperfections include damage to the coating system, experienced during installation or operation, in-situ coating degradation or mechanical damage, or coating discontinuities. External corrosion of the steel structure should not take place provided that the cathodic protection system remains active. However, the sacrificial anodes are finite and will eventually be consumed at which point the structure is no longer protected. Once this occurs, the steel structure will begin to externally corrode at any exposed areas where oxygen can access the metal. Corrosion rates in stagnant, slow-moving seawater are expected in the range of 0.1–0.2 mm/yr.

The RTM's cathodic protection is aluminium anodes comprising materials listed in **Table 6-19.** The anodes have a 20 year design life, and although the RTM was installed offshore during 2006, measurement of anode depletion in 2016 estimated only a 25% depletion. Demand on the sacrificial anodes is expected to decrease once installed on the seabed due to increased water depth, which will have reduced oxygen content and reduced current forces and up to a third of the structure will be protected from seawater by being smothered by the seabed. As such, cathodic protection could continue for a further 20–50 years following installation on the seabed. During this time, marine growth is expected to establish on the structure, and the coating is expected to degrade due to water osmosis, marine growth and microbial activity.

Once the sacrificial anodes have been exhausted, the RTM external steel surface will steel will start to corrode. There are two mechanisms in which metals in marine environments breakdown, erosion, and corrosion. Erosion can be considered negligible as a low flow rate around the structure is expected, and additionally, the metal surfaces of the structure would be shielded by the marine growth and the coating system from direct impaction.

Corrosion would be expected to occur due to oxidisation and corrosion from microbial action, both of which would be localised to the areas exposed due to the imperfections in the coating system. At these points of imperfection, based on the materials involved, water depth and temperature, corrosion is likely to be a relatively slow process, and would be expected in the order of 0.1–0.2 mm/year (Reinhart and Jenkins, 1972). This slow rate is also due to the structures colonising with marine growth over time, providing the structure with natural protection from corrosion.

At a corrosion rate of 0.1-0.2 mm/year, the RTM structure will take between 100 to 400 years to corrode and fully degrade. This corrosion will only occur following the degradation of the cathodic protective coating (20-50 years). Furthermore, the actual duration for the RTM to completely degrade is expected to be longer due to the presence of marine growth which is predicted to form a barrier that will reduce physical degradation.

Corrosion by both oxidation and microbial action will result in the formation of predominately iron hydroxide ($Fe(OH)_2$ or $Fe(OH)_3$), due to iron being the main constituent of the steel (approximately 98%). Once the RTM begins to degrade (i.e. following degradation of cathodic protection), between three and twelve tonnes of iron hydroxide a year will be produced and released to the environment through oxidation and microbial degradation. Constituents other than iron represent less than 2% of the composition of the carbon steel structure. Based on **Table 6-19**, these metal components will microbially corrode and or oxidise or into their hydroxide forms.

Based on this, the RTM will provide a structure for artificial habitat, shelter, upwelling and feeding opportunities to many marine species, both targeted recreational fishing species, as well as protected and other species for 100–400 years.

Breakdown and release of the RTM coating system (epoxy and paint)

The coating system on the RTM comprises a series of layers of epoxy and paint overcoat. The epoxy and primer paints, in their cured form are inert to marine environment, however they do contain some metal components, including, zinc, copper and potentially lead. As a the coating systems breaks down, it will release these components into the marine environment.

A TBT-free, copper-based anti-foulant paint was also applied. This has depleted and is 10 years beyond the 5-year design life, and is no longer considered active. This is evident by the level of marine biofouling seen in ROV video footage taken in February 2019 and previous ROV inspection reports.

Discharge of hydraulic fluid as RTM left in place breaks down

The RTM will be left in place with approximately 50 L of hydraulic fluid contained within 14 individual hydraulic lines into each compartment. The volume in each line varies between 1 L and 6 L, depending on the length of the line. Over time, the hydraulic lines will corrode and the fluid will slowly be released to the marine environment. Each line will degrade individually, resulting in the largest single release occurring as a slow leak of up to 6 L at a single point in time over the next 100 to 400 years. The hydraulic fluid initially installed in the lines during construction was a Shell Tellus 32 product, and was replaced with HW525 for ballast testing and planned decommissioning activities in 2018–2019. As the lines are only a single lines and cannot be looped, they are unable to be flushed.

Release of iron ore as RTM left in place breaks down

The RTM contains approximately 325 tonnes of iron ore in compartment 1, along with approximately 80 tonnes of concrete and the remainder seawater, which was used as ballast. The chemical composition of the iron ore is listed in **Table 6-18**. As the RTM hull degrades, the compartment will become compromised, eventually allowing the iron ore to be exposed. The iron ore is expected to have consolidated over time, becoming a solid mass, resulting in slow deterioration from current movement over time, dissipating into the surrounding environment and due to the specific gravity being greater than seawater (range is from 4 to 5), will precipitate into the surrounding marine sediments.

These components are all naturally occurring locally sourced materials, and as such are considered to not pose a risk to the receiving environment.

Table 6-18: Composition of iron ore in Compartment 1

Component	*Percentage (%)*	*Total Weight (tonnes)*
Aluminium oxide (Al_2O_3)	4.0–4.9	11.9–14.6
Silicone dioxide (SiO_2)	4.5–6.9	13.4–20.5
Titanium dioxide (TiO_2)	13.7–14.4	40.7–42.8
Iron (III) oxide (Fe_2O_3)	66.9–71.2	198.7–211.5
Manganese (II) oxide (MnO)	0.31–0.32	0.9–1.0
Calcium oxide (CaO)	0.5–1.3	1.5–3.9
Potassium oxide (K_2O)	0.02	0.06
Magnesium oxide (MgO)	1.8–2.1	5.3–6.2
Sodium oxide (Na_2O)	<0.05–0.11	0.1–0.3
Total		**297**

Degradation of the concrete reef modules left in place and concrete in the RTM

There will be 24 large and 24 small concrete reef modules installed as part of the IAR. The large reef modules are 4 m x 4 m x 5 m high. The small concrete modules are 2 m in diameter and 1.8 m high. There is also 80 tonnes of concrete in compartment 1 of the RTM. The concrete is a mixture of water, cement and sand or aggregate. Concrete exposed to seawater deteriorates over time from the combined effects of chemical and physical processes, including, sulphate attack; leaching of lime (calcium hydroxide); alkali-aggregate expansion; and erosion and abrasion from waves. Once the concrete modules are installed, they will be susceptible to both physical and chemical degradation.

Physical degradation of concrete occurs through sand and wave erosion. The currents expected to occur at the IAR location are relatively low, and the concrete modules are expected to provide a hard substrate that will rapidly colonise with marine growth and provide a level of protection from physical degradation.

Chemical degradation will occur due to magnesium sulphate present in seawater. This reacts with the calcium hydroxide in the cement and forms calcium sulphate, as well as magnesium hydroxide precipitation. Magnesium sulphate also reacts with hydrated calcium aluminate in cement and forms calcium sulfo-aluminate. These final formations are the primary reasons for chemical attack on concrete structures. The lime content present in concrete is also lost due to leaching, particularly as calcium hydroxide and calcium sulphate are both soluble in seawater.

The primary products of chemical degradation of concrete (calcium sulphate, magnesium hydroxide) are included on the PLONOR list (OSPAR, 2019).

The design life of the concrete reef modules is 50 years. This is a minimum life expectancy for the structures. The actual duration for the concrete reef modules to degrade is expected to be significantly longer, given the design life is a minimum duration and given the presence of marine growth that protects the structures from degradation.

Impact Assessment

Potential impacts to environmental values

Corrosion and breakdown of the RTM left in-situ

In the marine environment, as the RTM degrades it will release corrosion products. The corrosion products are predominantly iron hydroxide (>98%), which will be dislodged slowly from the structure over 100 to 400 years by ocean currents, and disperse in the water column to settle out into marine sediments. Iron hydroxide is an inert form of iron, and has a very low toxicity. There are currently no trigger values for iron or its forms of hydroxide in the marine environment and as such is considered to no threat the receiving marine environment (ANZECC and ARMCANZ 2000).

Release of the other metallic components of the steel will be very low due to their small percentage and long corrosion duration (100 to 400 years). Nickel hydroxide, chromium (III) hydroxide, molybdenum hydroxide, copper hydroxide, niobium hydroxide and vanadium hydroxide are inorganic, and will adsorb to sediment, becoming immobile as a result. They are not toxic, and are found naturally in the marine environment of the IAR.

Given the low toxicity of iron hydroxide and other carbon steel components, the slow release rate and rapid dilution of the open ocean environment, it is likely that any impacts to marine sediments, benthic habitats and water quality will be largely localised and not significant.

Breakdown and release of the RTM coating system (epoxy and paint)

Most RTM coating systems are benign once hardened in their dry form, however, there are certain components that can cause harm. In the RTM coating system, these components are copper, zinc and potentially lead.

<u>Copper</u>

Whilst copper is an essential nutrient for humans, plants and animals, including marine organisms, needed in low concentrations, excess copper can have detrimental effects. This is evidenced by it use in anti-foulant paints, preventing establishment of key fouling species. The anti-foulant paint applied to the RTM was Sigma Plane Ecol HA Antifouling 7385. Three coats of 125 µm were applied to achieve total design thickness of 375 µm and five-year design life. When new, the paint is a high activity, TBT-free, self-polishing anti-fouling paint, with cuprous oxide and organic biocides for aggressive fouling conditions.

Copper-based paints are considered the most effective and most common of the anti-foulant paints since the global ban of TBT-based anti-foulant paint by the IMO in 2008 (Lindgren et al., 2018). In simple terms, self-polishing paints are designed to work through a mechanism whereby upon immersion in seawater chemical bonds are broken, resulting in dissolution of the biocide (i.e. cuprous oxide) in a controlled manner, and exposure of a fresh layer of active surface, thereby preventing growth from establishing. This depletes the amount of copper in the paint over time. Once the rate falls below an activity threshold level, the concentration is no longer biocidal, and fouling establishes and grows as the concentration of copper in the paint decreases over time.

Both the US EPA and Canadian Environment Authority have issued guidance for environmental management of artificial structures proposed to be repurposed for creating artificial reefs (US EPA, 2006; Environment Canada, 2007). Both the US and Canada identify the biocidal activity of copper anti-foulant to be minimal if >12 years of age. The RTM was installed in the water in 2005 and the anti-foulant paint not been recoated in its 15 years of operation. The level of marine biofouling and ineffectiveness of the anti-foulant paint on the RTM can be seen in ROV video footage taken from the last subsea inspection in February 2019. As a result, the anti-foulant properties of the paint is no longer considered active, and therefore any residual cuprous oxide remaining is at low concentrations.

As a result, it is considered not credible that uptake of any residual copper by marine growth on the RTM would be at levels that could cause toxic effect, or bioaccumulate in fish foraging on the growth. Copper is also commonly regulated by organisms through being processed internally and excreted (ANZECC and ARMCANZ, 2000; CSIRO, 2016).

There may be low residual portion of copper remaining in the paint (up to 10% of that originally applied at manufacture) that can be released through the eventual deterioration and flaking of paint, which could potentially accumulate in sediment. A manufacturer's specification sheet is available for the paint, however the percentage of cuprous content of the paint is not specified. Scientific studies report that the copper content of various anti-foulant paint ranges between 7—75% wt% (wet) (Lindgren et al., 2018). Based on marine coating applications similar to the RTM from these studies, the estimated copper content of the paint is 60%.

There are several laboratory and mass-balance methodologies used by regulatory and decision-making bodies worldwide, for estimating anti-foulant leach rates following application to hulls (OECD, 2005; 20012) (for example, ISO 10890:2010). Recent Australian Guidelines (AVPMA, 2020) for estimating antifoul leaching rates, based on one of the internationally generally accepted methods, assumes a residual (non-leachable) component of 10%. This means it is reasonable to assume that at least 90% of the original copper content has already leached out of the RTM's paint and only a low portion remains. An estimate 940 kg of the anti-foulant paint applied has been estimated as copper. With 10% remaining, this is approximately 94 kg. The degradation of the paint will occur over a similar timeframe to the RTM hull, degrading over 100 to 400 years.

It is possible over time, that flaking of paint from the RTM containing residual non-depleted copper could lead to some elevation of sediment copper levels. This poses most risk to benthic fauna. As any flaking of paint is expected to occur gradually over time, it is not expected that copper will accumulate in sediment to levels causing adverse impacts to benthic organisms. While some trophic transfer is possible, most metals including copper generally do not biomagnify (CSIRO, 2016). Given this, it is not considered credible that copper would be ingested or biomagnify within fish to levels causing adverse effects.

When the RTM lands out on the seabed, the structure will settle into the sediment. The measured dry sediment density of the seabed at the IAR location is 2530 kg/m^3 from the field surveys. Assuming a worst credible scenario is that all the paint flakes off and lands within 5 m of the RTM structure, or is buried underneath the structure, the area within which the copper will accumulate is 1,740 m^2 (including under RTM and surrounding area). In the worst case, if the total copper paint accumulates within this area within a depth of 0.25 m, over an extended time period, the total copper in the sediment will be approximately 85.5 mg/kg (assuming no uptake by marine organisms and 100% accumulation into the soil). The default sediment quality threshold for copper is 65 mg/kg to 270 mg/kg as a High Guideline Value. Given the conservative assumptions in estimating copper concentration in sediment, including no biological uptake, and no movement of copper beyond 5m from the RTM, copper is not considered to have an impact on the marine environment.

Zinc

The RTM contains layers of primer containing zinc, and layers of zinc-based epoxy. Approximately 81 kg of zinc is contained with the coating system. It is possible that the zinc could be released through flaking paint layers, or RTM breakdown, accumulating in the sediments surrounding the RTM, over time. Contaminants in sediments may be directly toxic to aquatic organisms or can be a source for bioaccumulation or biomagnification in the food chain, if above a certain threshold. The threshold for zinc in marine sediments is 200 mg/kg (dry weight). Marine organisms can regulate tissue residues of zinc over wide ranges of zinc concentrations in the ambient water, sediments and food, it is only moderately toxic to some organisms. Fish are the most tolerant, phytoplankton and some larval molluscs the most sensitive.

Assuming the worst case described above for copper, the total zinc in the sediment will be approximately 73.6 mg/kg (assuming no uptake by marine organisms and 100% accumulation into the sediment). The default sediment quality threshold for zinc is 200 mg/kg to 410 mg/kg as a High Guideline Value. The estimated accumulation of zinc in the sediment is below the lowest threshold value and therefore not considered to have an impact on the marine environment.

Lead

There is a potential that one of the paint layers used on the RTM contains lead. While lead based paint was phased out of residential paints in the 1970's in Australia, and most other high-income countries, lead-based industrial paints have been, and still are used for marine applications (Gottesfeld, 2015). Lead can be toxic and harmful to marine organisms. The toxicity of lead is reduced by low solubility of many forms of lead in the natural environment, particularly in alkaline waters, such as seawater which is slightly alkaline, with a pH of between 8.0 and 8.6. Lead is strongly complexed by dissolved organic matter in most natural waters and speciation in seawater is dominated by chloride complexing, which becomes negligible at salinities below approximately 6%. Hence increasing salinity reduces toxicity. Lead can bioaccumulate in aquatic organisms but it is generally not available at sufficient concentrations to cause significant problems (ANZECC and ARMCANZ, 2000).

If lead paint was used on the RTM, it would have had an estimated 5–10% lead chromate molybdate sulfate red, with the total lead in the paint on the RTM estimated between 33 and 66 kg. Assuming the worst case described above for copper, this would lead to a total lead in sediments of between 30 and 60mg/kg.

The default ANZECC guideline value for lead in sediment is 50 mg/kg, with a High Guideline Value = 220 mg/kg. Therefore, there it is unlikely that there would be any impact on organisms from lead.

Discharge of hydraulic fluid as RTM left in place breaks down

The HW525 water based hydraulic fluid will gradually be released to the environment from the RTM as the hydraulic lines degrade over 100 to 400 years. The most credible scenario is corrosion occurs until a line is degraded to a point of perforation. At this point, a leak will occur, and as hydraulic fluid is less dense than seawater, the fluid will release. Upon release, the droplets would be diluted, discharged locally. The largest volume of the longest hydraulic line is 6 L, the total volume of which would pose little threat to the environment. HW525 is an OCNS ranked A chemical, having a high hazard ranking. A slow release of up to 6 L (worst credible scenario) would have a highly localised, short-term impact to water quality as the hydraulic fluid discharges in the currents.

Release of iron ore as RTM left in place breaks down

The components of iron ore are all naturally occurring locally sourced materials, and as such are consider to have a negligible impact on the receiving environment. As the RTM degrades and exposes the consolidated iron ore, erosion of the mass is expected, which will create short-term and localised resuspension events, as the iron ore releases and settles out into the surrounding sediments. This is not expected to affect the marine environment.

Degradation of the concrete reef modules left in place and concrete in the RTM

The primary products of chemical degradation of concrete (calcium sulphate, magnesium hydroxide) are included on the PLONOR list (OSPAR, 2019). As such, no impacts to the marine environment from the degradation of the concrete modules is anticipated.

Summary of potential impacts to environmental values(s)

Potential impacts to water quality, ecosystems / habitats

There is no credible mechanism for extensive physical or chemical degradation of the polyurethane foam and bend stiffeners if the grout containment breaks down over time. Therefore, it is not expected that the foam and any remaining bend stiffener plastic material will physically break down into either larger pieces (macroplastics), or into meso- or microplastic sized pieces that could be ingested by benthic biota such as invertebrates and fishes. If any larger pieces of foam break away from the foam/grout matrix they would be negatively buoyant (due to compression of the foam via hydrostatic pressure), and so would sink to the seabed. Similarly, if any larger pieces of remaining bend stiffener plastic material breaks way (and this is highly unlikely to occur) these pieces would be negatively buoyant due to the density of this material. There are no credible mechanisms for these larger pieces to be broken down in to meso- or microplastics.

The degradation of the RTM steel structure over time would release predominantly inert iron hydroxide (>98% of the steel is iron) and would only occur over a long period (100 to 400 years). The degradation would also lead to release of quantities of metals both used as alloys within the steel structure, and within the paint (copper, zinc, and potentially lead), which would degrade over similar timeframes. The quantities at which they are present may result in a temporary, localised alteration in sediment quality, but this is not likely to cause any significant impacts to sensitive receptors near the RTM (e.g. sediment macrofauna/infauna; benthic habitats/fouling communities; benthic fish assemblages; demersal and pelagic fishes targeted by recreational and commercial fishers).

Other components of the RTM released over time include the degradation of iron ore, and small quantities of hydraulic fluid (released in quantities between 1 L and 6 L). These will also have negligible impacts on the localised area, and are not likely to cause any significant impacts to sensitive receptors near the RTM (e.g. sediment macrofauna/infauna; benthic habitats/fouling communities; benthic fish assemblages; demersal and pelagic fishes targeted by recreational and commercial fishers), as they are released over the next 100 to 400 years.

The degradation of the concrete reef modules will also have negligible impacts on the marine environment.

Potential impacts to protected species, values of the Ningaloo Coast WHP/AMP, KEFs and social values

Any physical or biological degradation of the RTM, coating system, iron ore, hydraulic fluid and reef modules, and bend stiffeners will not result in the release of contaminants that could potentially become bioavailable and bioaccumulate in any protected species that use the waters near the RTM disposal location (e.g. pygmy blue whales, marine turtles, whale sharks, seabirds). Any decline in sediment quality from degradation of the RTM or reef tower modules over time will not impact on any physical or ecological values of the Ningaloo WHP, the Ningaloo AMP, or of any KEFs in the region. Similarly, any degradation of the structures and release of degradation materials, paint flakes, iron ore or hydraulic fluid will not impact on any of the social values of the RTM disposal location, or of the adjacent WHP and AMP.

Given the highly localised nature of the discharges and potential impacts, cumulative impacts to marine biota, water quality and sediments would be minor.

Demonstration of ALARP

Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[46]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Legislation, Codes and Standards (other than OPGGS Act)				
Approval of an artificial reef permit under the Sea Dumping Act 1981, which ensures the following (DAWE, 2008): • an appropriate site has been selected • the materials are suitable and prepared properly • no significant adverse impact on the marine environment occurs • the reef does not pose a danger to navigation, fisherman or divers • the artificial reef is charted on maritime maps.	F: Yes CS: Minimal cost. Standard practice.	Artificial reef permit application process ensures that the proposal for the IAR is environmentally acceptable and that the IAR will serve a purpose (DAWE, 2008).	Control based on legislative requirements – must be adopted.	Yes 19.1
Good Practice				
Ongoing, regular surveys of the IAR	F: Yes. CS: Moderate cost.	Long term monitoring of the IAR will be performed by Recfishwest, as required under the artificial reef permit. This is described in **Section 7.5.4**.	Control based on legislative requirements – must be adopted.	Yes 19.2

[46] Qualitative measure

Professional Judgement – Eliminate				
Flush risers to ALARP concentrations of hydrocarbons	F: Yes. CS: Minimal Cost	Flushing of the risers avoids the release of up to 50 L hydrocarbons in the risers to the marine environment.	Benefits outweigh cost/sacrifice.	Yes C 22.1
Flush topsides chemical piping and umbilical	F: Yes. CS: Moderate Cost	Flushing of the topsides chemical piping and umbilical avoids the release of chemicals remaining in the piping/ umbilicals at the IAR location. Note umbilical would be flushed in less sensitive deepwater marine environment in the title area.	Benefits outweigh cost/sacrifice.	Yes C 22.2
Decant drain pot and bring contents onshore	F: Yes. CS: Moderate Cost	Decanting the drain pot while RTM is in its current location in the title area avoids the release of chemicals at the IAR location.	Benefits outweigh cost/sacrifice.	Yes 22.3
Flush hydraulic fluid from ballast valve control lines	F: These lines do not have a return line loop system and cannot be flushed back to surface. CS: Not feasible	Flushing the lines would avoid the release of up to 50L of hydraulic fluid.	Not feasible. Negligible environmental impact.	No
Physically remove foam before sinking RTM and dispose of onshore	F: Physically removing foam from compartment 13 with the RTM moored would require a minimum of 7 people due to confined space entry safety requirements, which exceeds the number of people allowed on RTM under the Safety Case. Recent Woodside experience of foam removal from an RTM ballast compartment took 2 months. This was in a situation where confined space entry could be undertaken with the required number of people and the foam was foam batts, which was easier to remove than expanded foam, which would require a method to break up for removal. Even if a confined spaced entry was able to be undertaken on NGA RTM, given personnel and	Not considered – control not feasible	Not considered – control not feasible	No

	equipment access limitations and the expandable foam, it would be expected to take significantly longer than 2 months. Given limitations on confined space entry this is not considered feasible. CS: Control not feasible.			
Chemically dissolve foam	F: Dissolution of foam with acid could potentially be conducted using ROV. The volume of acid required to dissolve foam in the 65m3 compartment would likely be approximately 3 times the volume of the compartment volume (195m3/ 195,000l), which would require a dedicated vessel. Acid could be injected using the access pipe into the compartment, however this would rely on contacting the 65 m^3 of foam using one access point, and would require multiple iterations of pumping acid into the compartment and recovering the dissolved acid/ foam mixture, which would take about 1 week. Due to the location of the access pipe to the compartment, recovering all the acid and foam would be difficult and its expected that approximately 20–30% of the acid and foam would remain in the compartment (19,500 L of acid and 1.95 tonnes of foam). CS: significant cost	Removal of 70–80% of foam. This requires using and disposing of a large volume of acid, with associated environment and health and safety risks.	Due to the large volume of acid required and associated environment and health and safety risks, along with the residual acid and foam that would remain in the compartment, the benefits do not outweigh the cost.	No
Cut out compartment 13 while on seabed	F: Diamond wire cutters are used to cut marine structures and this method has been considered for cutting compartment 13 from the RTM once on the seabed. The largest existing diamond wire cutter identified was ~5 m diameter. The RTM has a diameter of 8.5 m, so while the technology exists, the size and capacity does not. A new cutter could potentially be constructed;	Foam would be removed. Some seabed impact associated with use of cutting equipment.	Given equipment of the required size and capacity does not exist, and would have a significant lead time and cost, this is not considered practicable.	No

	however this would have a long lead time (6–9 months). Removing the compartment would be complex and would require removing the RTM access steel framework (including ladders) and other external equipment on seabed to reduce the effective diameter to 8.5 m, before using the cutter. CS: Significant cost			
Remove risers and EHU from RTM	F: Yes. Feasible if risers and EHU are removed once RTM is on the seabed. CS: Significant cost.	Reduction in environmental impact from degradation of 14.6 tonnes of plastics.	Benefits outweigh cost/sacrifice.	Yes C 22.4
Remove riser bend stiffeners as close as possible to bottom of RTM	F: Yes. Feasible to cut bend stiffeners using ROV CS: Moderate Cost	Reduction in environmental impact from degradation of 6.2–9 tonnes of plastics. Due to access at bottom of RTM, up to 0.5 m of riser bend stiffener may remain in place following cutting of bend stiffener using ROV.	Benefits outweigh cost/sacrifice.	Yes C 22.5
Remove residual plastics from the topsides of the RTM (electrical cabling insulation, chemical lines, valves and gauges).	F: Yes. Significant portion of plastics can be removed from topside including electrical cabling and chemical lines. CS: Reasonable cost, but acceptable.	Reduction in environmental impact from degradation of plastic over time.	Benefits outweigh cost/sacrifice.	Yes C 22.6
Remove paint from RTM before placement on seabed as part of IAR	F: Yes. CS: Significant cost. Would require ROV operation using blasting or abrasion to remove multiple layers of paint coating from an area of >1800 m^2. No option for capturing the paint as it is stripped from the RTM, given the RTM cannot be lifted out of the water.	Little environmental benefit given negligible impact associated with paint and given paint removed would remain in the marine environment.	Cost of the control is disproportionate given the impact of the paint remaining on the RTM is low, and even if the paint was removed, it is unable to be collected for elimination of impacts in the marine environment.	No
Remove iron ore from RTM	F: It is expected that the iron ore will have settled on the bottom of compartment #1 and solidified into one large mass since installation in	Little environmental benefit given negligible impact associated with iron ore.	Not feasible to remove.	No

	2006 meaning it is not feasible to remove. CS: Not feasible.			
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Encapsulate compressed foam in grout	F: Yes. Foam predicted to compress to 10% of volume of compartment, enabling void space to be filled with grout, encapsulating the foam. CS: Reasonable cost.	Encapsulate foam from the marine environment reducing likelihood of harm from degraded foam pieces fragmenting and entering the environment as macroplastics.	Benefits outweigh cost/sacrifice.	Yes C 22.7
Encapsulate any remaining bend stiffener that is unable to be cut using ROV in grout	F: Yes. Bend stiffeners can have a mould created to enable the remnant stub to be encapsulated in grout. CS: Reasonable cost.	Encapsulate bend stiffeners from the marine environment reducing likelihood of harm from degraded foam pieces fragmenting and entering the environment as macroplastics.	Benefits outweigh cost/sacrifice.	Yes C 22.8
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of the corrosion and breakdown of RTM left in-situ. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that routine and non-routine discharges from the RTM and reef modules degrading and corroding from being left in place permanently, may result in localised impacts with no lasting effect (<1 month) to deepwater benthic habitats. However, the environmental benefits of leaving the RTM and reef modules in place as an IAR delivers greater environmental outcome than the localised environmental impacts, given the benefits are over a minimum 100 years, and will create a productive marine habitat during this period. Given this, Woodside considers the impact broadly acceptable for the RTM to be repurposed into an IAR.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 19 Repurposing the RTM as an IAR will comply with the requirements of the Sea Dumping (Environmental Protection) Act 1981.	**C 19.1** Refer to **Section 6.7.1.1**.	**PS 19.1** Refer to **Section 6.7.1.1**.	**MC 19.1.1** Refer to **Section 6.7.1.1**.
	C 19.2 Refer to **Section 6.7.1.1**.	**PS 19.2** Refer to **Section 6.7.1.1**.	**MC 19.2.1** Refer to **Section 6.7.1.1**.
			MC 19.2.2 Refer to **Section 6.7.1.1**.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 22 No impacts to the marine environment from the long-term degradation of the RTM greater than a consequence level of F[47].[48]	**C 22.1** Flush risers to ALARP concentrations of hydrocarbons	**PS 22.1** Risers flushed before removing the RTM from the title area	**MC 22.1.1** Records demonstrate that risers have been flushed.
	C 22.2 Flush topsides chemical piping and umbilical	**PS 22.2** Topsides chemical piping and umbilical flushed in accordance with contractor procedures	**MC 22.2.1** Records demonstrate that topsides chemical piping and umbilical have been flushed.
	C 22.3 Decant drain pot and bring contents onshore	**PS 22.3** Drain pot decanted in accordance with contractor procedures	**MC 22.3.1** Records demonstrate that drain pot has been decanted
	C 22.4 Remove risers and EHU from RTM.	**PS 22.4** Risers and EHU removed from RTM to the maximum extent practicable by horizontal pull once in situ, in accordance with documented Contractor procedures.	**MC 22.4.1** Records (e.g. as left survey report) demonstrate that risers and EHU have been removed to the maximum extent practicable by horizontal pull once in place
	C 22.5 Remove riser bend stiffeners as close as possible to bottom of RTM	**PS 22.5** Bend stiffeners cut and removed to the maximum extent practicable by ROV in accordance with documented contractor procedures.	**MC 22.5.1** Records (e.g. as left survey report) demonstrate that bend stiffeners have been cut and removed to the maximum extent practicable by ROV
	C 22.6 Remove residual topside plastics in the RTM (electrical cabling insulation, chemical lines)	**PS 22.6** <10 kg of plastics remaining in the RTM topsides	**MC 22.6.1** Records (e.g. removed item inventory relative to design) demonstrate that residual plastic components are <10 kg
	C 22.7 Encapsulate compressed foam in grout	**PS 22.7** Compressed foam in RTM encapsulated in grout in accordance with documented contractor procedures	**MC 22.7.1** Records (e.g. As Left survey report) demonstrate that compressed foam in RTM has been encapsulated in grout
	C 22.8 Encapsulate any remaining bend stiffener that is unable to be cut using ROV in grout	**PS 22.8** Remnant pieces of bend stiffener encapsulated in grout in accordance with documented Contractor procedures	**MC 22.8.1** Records (e.g. As Left survey report) demonstrate that remnant pieces of bend

[47] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.'

[48] Once installed to design specifications outlined in the artificial reef permit, ownership of the IAR will transfer to the WA State Government (DPIRD) under monitoring and management by Recfishwest (**Section 1.10.1.3**). In the unlikely event that adaptive management is required, this will be undertaken under by the State/Recfishwest with oversight from DAWE. **Section 7.5.4** outlines long-term monitoring commitments which will be commited to as part of the artificial reef permit.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
			stiffener have been encapsulated in grout

6.7.1.4 Routine Discharges: Project Vessel Operations within Operational Area 2

Context		
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**	

Impacts and Risks Evaluation Summary												
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine discharge of sewage, grey water and putrescible wastes to marine environment from project vessels operating within Operational Area 2			X					A	F	LCS GP PJ	Broadly acceptable	EPO 6
Routine discharge of deck and bilge water to marine environment from project vessels operating within Operational Area 2			X					A	F			
Routine discharge of cooling water or brine to the marine environment from project vessels operating within Operational Area 2			X					A	F			

Description of Source of Impact

It is expected to take around 15–20 days and three vessels (1x PIV for the duration, and 2x AHTs for placing the RTM) to tow, place, and stabilise the RTM as an IAR on the seabed along with placing the purpose-built reef tower modules. The project vessels are expected to routinely generate/discharge the following:

- Small volumes (typically 15 m^3 per project vessel per day) of treated sewage, grey water and putrescible wastes to the marine environment.
- Routine/periodic discharge of relatively small volumes of bilge water. Bilge tanks on project vessels receive fluids from many parts of the vessel. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals.
- Variable water discharge from project vessel decks directly overboard or via deck drainage systems. Water sources could include rainfall events and/or from deck activities such as cleaning/wash-down of equipment/decks.
- Cooling water from machinery engines and brine water produced during the desalination process of reverse osmosis to produce potable water on board project vessels.

Environmental risk relating to the disposal/discharges above regulated levels or incorrect disposal/discharge of waste would be unplanned (non-routine/accidental) and are addressed in **Section 6.7.2.4**.

Impact Assessment

Potential impacts to environmental values

The main environmental impacts associated with discharges from project vessels are described in **Section 6.6.1.3**. Given the tow, placement, sinking and augmentation of the RTM as an IAR is expected to take around 15–20 days and produce only small volumes of discharges from a small number of vessels, as well as the expected localised

mixing zone and high level of dilution into the open water marine environment of Operational Area 2 (16 km or 9 nm off North West Cape), impacts are expected to be consistent with those described for Operational Area 1. Vessels conducting the activity will be subject to the requirements of relevant Marine Orders, including more strict requirements when within 12 nm from land (Operational Area 2 extends into this area at the IAR location). Given the tow, placement, sinking and augmentation of the RTM as an IAR is expected to take around 15–20 days and produce only small volumes of discharges, cumulative impacts to water quality within the Operational Areas are expected to be localised and short-term with no lasting effect. Given the limited spatial and temporal nature of the discharges, and boundaries defined for Operational Area 2, no impacts within the Ningaloo AMP and WHP will occur.
Summary of potential impacts to environmental values(s)
Given the adopted controls, it is considered that routine or non-routine discharges described will not result in a potential impact greater than localised, short-term contamination not significant to environmental receptors, with no lasting effect.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)**[49]	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps to pass through a macerator so it is capable of passing through a screen with no opening wider than 25 mm.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 6.1
Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention Certificate, as required by vessel class • an AMSA-approved sewage treatment plant • a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 nm from the nearest land • discharge of sewage which is comminuted or	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 6.2

[49] Qualitative measure

disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 nm from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (> 4 knots), to avoid discharges in environmentally sensitive areas.				
Marine Order 91 – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water before discharge: • Machinery space bilge/oily water shall have IMO-approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure Oil in Water (OIW) content to be less than 15 ppm before discharge. • IMO-approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating if OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • If machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed onshore.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 6.4

• Valid International Oil Pollution Prevention Certificate.				
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
Storage, transport and treatment / disposal onshore of sewage, greywater, putrescible and bilge wastes.	F: Not feasible. Would present additional safety and hygiene hazards resulting from the storage, loading and transport of the waste material CS: Not considered – control not feasible	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impact of planned (routine and non-routine) discharges from project vessels. 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, planned discharges (routine) from project vessels is unlikely to result in a potential impact greater than temporary contamination above background levels and/or national/international quality standards and/or known biological effect concentrations outside a localised mixing zone with no lasting effect. 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 95 and 96. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 6 No impact to water quality greater than a consequence level of F[50] from	**C 6.1** Refer to **Section 6.6.1.3**	**PS 6.1** Refer to **Section 6.6.1.3**	**MC 6.1.1** Refer to **Section 6.6.1.3**
	C 6.2 Refer to **Section 6.6.1.3**	**PS 6.2** Refer to **Section 6.6.1.3**	**MC 6.2.1** Refer to **Section 6.6.1.3**

[50] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
discharge of sewage, greywater, putrescible wastes, bilge and deck drainage to the marine environment during the Petroleum Activities Program.	**C 6.4** Refer to **Section 6.6.1.3**	**PS 6.4.1** Refer to **Section 6.6.1.3**	**MC 6.4.1** Refer to **Section 6.6.1.3**
		PS 6.4.2 Refer to **Section 6.6.1.3**	**MC 6.4.2** Refer to **Section 6.6.1.3**

6.7.1.5 Routine and Non-routine Discharges: Hydrocarbons and Chemicals from removal of risers, and excess grout from foam and bend stiffener encapsulation

Context		
IAR Activities – **Section 3.7.4** Assessment of Project Chemicals – **Section 3.13**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**	Stakeholder Consultation – **Section 5**

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Non-routine discharges of hydrocarbons within Operational Area 2 during removal of risers			X					A	F	LCS GP PJ	Broadly acceptable	EPO 7 and 19
Non-routine discharges of excess grout within Operational Area 2 from foam and bend stiffener encapsulation		X			X			A	F			

Description of Source of Impact

Hydrocarbon Discharges from Removal of Risers and EHU

During the Petroleum Activities Program, small volumes of residual hydrocarbons may be released from the riser sections during their removal from the RTM. The risers were flushed prior to FPSO in the title area therefore only trace quantities are likely to remain on the interior surface. The volume of residual hydrocarbons in the risers has been calculated based on the OIW concentrations during flushing of the risers to be about 500 ml. As such, on removal of the risers at the IAR location, there is potential for up to 500 ml of hydrocarbons to be released.

There are no other hydrocarbons or chemicals within the RTM, and therefore there is no future potential for hydrocarbon or chemical release from the RTM once in place as an IAR.

Excess Grout Discharges

To secure and encapsulate the compressed foam in compartment #13, grout will be used to fill the void left following compression. The foam is estimated to shrink by up to 90% (i.e. up to approximately 10% of its original volume of 65 m^3) due to the hydrostatic pressure at depth. Between 36 m^3 and 65 m^3 of grout will be required to fill the void space. An ROV will be monitoring the hole in the RTM at compartment #13 during pumping, and the vessel pump will be stopped once grout appears at the mouth of the hole. An overspill of grout of up to approximately 2 m^3 may be released to the seabed once the void is filled. An ROV will also be used to grout any remaining non-metallic portions of the bend stiffeners if they are unable to be removed (**Section 6.7.2.1**). A containment vessel will be used to cap/surround the end of the bend stiffeners/riser tails, which grout will then be injected into. Approximately 5–10 m^3 of grout is expected to be required to fully grout any remaining bend stiffener non-metallic material or non-removable riser tails. An ROV will be monitoring the grouting during pumping, and the vessel pump will be stopped once grout appears around the top or edges of the containment vessel. An overspill of grout of up to approximately 2–3 m^3 may be released to the seabed once the remaining bend stiffener material or riser tails are fully encapsulated.

Impact Assessment

Potential impacts to environmental values

Hydrocarbon Discharges from Removal of Risers

In sufficient volumes, hydrocarbon exposure may lead to mortality to marine organisms within the immediate vicinity of a discharge plume, as well as sub-lethal chronic (long exposure) effects (Neff et al., 2011) as described in **Section 6.6.1.4**. However, the impacts from the release of small residual hydrocarbons is significantly reduced.

Further details on potential biological and ecological impacts associated with significant hydrocarbon spills are presented in **Section 6.6.2.2**.

The maximum loss of residual hydrocarbons is 500 ml as the risers have been previously flushed. Given the small quantities expected to be released, impacts to any receptors are highly unlikely and will have no lasting effect to water quality.

Excess Grout Discharges

Grout discharges are not expected to widely disperse and will settle on the seabed in the immediate vicinity of the RTM. Therefore, the impact of grout discharge at the seabed will be limited to affecting sediment quality and any surrounding benthic and/or infauna communities, in a small localised area immediately below the RTM compartment 13 location and around the end of the bend stiffeners. All the chemicals that make up the cement component of grout (calcium oxide/hydroxide, silica, alumina, iron, gypsum) are included on the PLONOR list (List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment) (OSPAR, 2019).

The seabed in Operational Area 2 comprises soft, unconsolidated sediments hosting sparse infauna and epifauna assemblages. This habitat is widely represented in the region. As such, the seabed subject to potential grout discharges is considered to be of low sensitivity. Benthic habitats observed at the proposed location for the IAR are almost entirely comprised of bare silty sand, with epibiota (solitary cnidarians, one hermit crab specimen) occurring in densities <1% of ROV transects. Fish populations are relatively sparse, and are comprised of species with low recreational or commercial value. This habitat is widely represented in the region. Surveys of IAR location did not detect any hard substrates or hard coral dominated communities. The nearest hard coral communities (e.g. Helby Banks) are located in water depths <40 m, at least 11 km distance away (**Section 4.3**). As such, the seabed subject to potential cement discharges is considered to be of low sensitivity. Any potential impacts will be to individuals in the immediate location with no lasting effect to the species or communities.

Given the limited spatial and temporal nature of the discharges, no impacts within the Ningaloo AMP or WHP will occur.

Summary of potential impacts to environmental values(s)

Given the adopted controls, it is considered that routine and non-routine discharges of the hydrocarbons and chemicals described will result in no lasting effect on benthic habitats and water quality due to the temporary contamination of water and seabed above background levels within Operational Area 2.

Demonstration of ALARP

Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[51]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Legislation, Codes and Standards (other than OPGGS Act)				
Approval of an artificial reef permit under the Sea Dumping Act 1981, which ensures the following (DAWE, 2008): • an appropriate site has been selected • the materials are suitable and prepared properly • no significant adverse impact on the marine environment occurs • the reef does not pose a danger to navigation, fisherman or divers • the artificial reef is charted on maritime maps.	F: Yes CS: Minimal cost. Standard practice.	Artificial reef permit application process ensures that the proposal for the IAR is environmentally acceptable and that the IAR will serve a purpose (DAWE, 2008).	Control based on legislative requirements – must be adopted.	Yes 19.1
Good Practice				
ROV used for constant monitoring during pumping to minimise excess grout released	F: Yes CS: Minimal cost. Standard practice.	Reducing grout discharge to the marine environment would reduce the likelihood and consequence of	Benefits outweigh cost/sacrifice	Yes C 7.7

[51] Qualitative measure

		impacts on local receptors		
Professional Judgement – Eliminate				
Flush all hydrocarbons from risers before removal from title area	F: Yes. CS: moderate	Hydrocarbons within the risers have been flushed to ALARP. Further flushing will not significantly reduce the already low impact without disproportionate cost sacrifice and complete flushing of all residual hydrocarbons is not considered feasible.	Disproportionate. Given the low volumes remaining in the risers, the cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of routine and non-routine discharges of minor quantities of hydrocarbons and chemicals. 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, routine and non-routine discharges of minor quantities of hydrocarbons and chemicals represent no lasting effect with only temporary contamination above background levels. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 7 No impact to water quality or marine biota greater than a consequence level of E[52] from discharging fluids during the Petroleum Activities Program.	**C 7.7** ROV used for constant monitoring during pumping to minimise excess grout released	**PS. 7.7** Pumping will cease upon visual confirmation of void overflow by ROV	**MC 7.7.1** Records demonstrate that grout pumping was monitored and ceased upon overflow.
EPO 19 Repurposing of the RTM as an IAR will comply with the requirements of the	**C 19.1** Refer to **Section 6.7.1.1**.	**PS 19.1** Refer to **Section 6.7.1.1**.	**MC 19.1.1** Refer to **Section 6.7.1.1**.

[52] Defined as 'Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
Sea Dumping (Environmental Protection) Act 1981.			

6.7.1.6 Routine Light Emissions from Activities within Operational Area 2

Context												
Project Vessels – **Section 3.10**						Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**						
Impacts and Risks Evaluation Summary												
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine light emissions from project vessels within Operational Area 2						X		A	E	LCS GP PJ	Broadly acceptable	N/A
Description of Source of Impact												
Three project vessels (one PIV and two AHTs) may be required for the activity in Operational Area 2. Vessels will be present in Operational Area 2 for a short duration (15–20 days) between December to April. However, the timing and duration of the activity is subject to suitable weather windows, cyclones and other delays. Routine lighting emissions from project vessels and the effect of light spill on the environment are described in **Section 6.6.1.5**.												
Impact Assessment												
Potential impacts to environmental values												

Receptors that have important habitat within a 20 km buffer of Operational Area 2 were considered for the impact assessment, based on recommendations of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (NLPG). The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15–18 km and fledgling seabirds grounded in response to artificial light 15 km away (NLPG 2020).

As described in **Section 6.6.1.5**, 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 night-time phase of the moon. Artificial lighting has the potential to create a constant level of light at night that can override these natural levels and cycles.
- *Orientation*: species such as marine turtles and birds may also use lighting from natural sources to orient themselves in a certain direction at night. In instances where an artificial light source is brighter than a natural source, the artificial light may override natural cues, leading to disorientation.

The fauna within and immediately adjacent to Operational Area 2 are predominantly pelagic fish and zooplankton, and transient species such as marine turtles, whale sharks, cetaceans and migratory shorebirds and seabirds. There is no known critical habitat within and immediately adjacent to Operational Area 2 for EPBC listed species. Operational Area 2 overlaps habitat critical to the survival of the species for marine turtles and turtle BIAs (Ref Section 4), and a BIA (breeding and foraging) for the wedge-tailed shearwater.

Marine Turtles – Hatchlings

As discussed in **Section 4.4.3.3**, turtles hatchlings emerge from the nest and orient towards the sea. After entering the water, hatchlings use a combination of cues (wave direction and currents) to orient and travel into offshore waters. Impacts to the sea-finding behaviour of hatchlings are more common for light sources behind a beach, as lighting offshore will orient emerging hatchlings towards the sea. Artificial light at close distances can also impact the dispersal of hatchlings once in the water. Light spill may ‘entrap’ hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predators via silhouetting (Salmon et al., 1992).

The nearest nesting beaches in relation to Operational Area 2 are along the western extent of North West Cape (approximately 16 km from the Operational Area) and the Muiron Islands (24 km from Operational Area 2). North West Cape is a nesting location habitat critical to the survival of green turtles, with nesting occurring November–March (peak: December–February) and hatching during January–May (peak: February–March). South Muiron Island (24 km from Operational Area 2) is a nesting location habitat critical to the survival of loggerhead turtles (nesting November–March, hatching January–May).

Light from project vessels is not expected to disorient hatchlings and impact the ability of hatchlings to reach the sea, as hatchlings are expected to orientate towards the light source offshore when leaving the beach. Once hatchlings reach the sea, the primary cue for hatchling turtle orientation is water movement, with hatchlings swimming towards oncoming waves (Lohmann et al., 1990, Lohmann and Lohmann 1992). While there are nesting beaches within 20 km of Operational Area 2, modelling of light emissions from larger vessels in the Dampier Archipelago (e.g. trailer suction hopper dredge and pipelay vessel) indicated that the actual zone within which behavioural responses in hatchlings could occur is <2 km (PENV 2020a). Given the distance from the nearest nesting location to Operational Area 2 of >16 km, impacts to emerging hatchlings are not expected. Artificial light may result in slight short-term behavioural impacts to isolated individual hatchlings offshore, which is not expected to result in significant impacts to green or loggerhead turtles at a population level.

Marine Turtles – Adults

Although individuals undertaking internesting, migration, mating (adults) or foraging (adults and pelagic juveniles) may occur within Operational Area 2, marine turtles do not use light cues to guide these behaviours. Further, there is no evidence, published or anecdotal, to suggest that internesting, mating, foraging or migrating turtles are impacted by light from offshore vessels. As such, light emissions from the vessels are unlikely to result in displacement of, or behavioural changes to individuals in these life stages (PENV 2020b).

Artificial lighting may affect where nesting adult turtles emerge onto the beach, the success of nest construction, whether nesting is abandoned, and the seaward return of adults (Salmon et al., 1995a, 1995b; Salmon and Witherington, 1995). Such lighting is typically from residential and industrial development overlapping the coastline, rather than offshore from nesting beaches.

North West Cape (about 16 km from Operational Area 2) is a known nesting location and light from the project vessels may be visible as sky glow to nesting adult turtles. Once they have finished laying, nesting females are thought to use light cues to return to open ocean, orientating towards the brightest light (Witherington and Martin, 2003). Artificial light from project vessels may be visible at nesting beaches, however as Operational Area 2 is 16 km from the nearest beach, direct light spill onto the beach is not considered credible. As such, the vessel light sources are not expected to discourage females from nesting, or effect nest site selection, and therefore will not displace females from nesting habitat.

Operational Area 2 overlaps internesting buffer habitat critical to the survival of loggerhead, flatback and green turtles, and BIAs for green turtle internesting, flatback turtle internesting, hawksbill internesting, loggerhead turtle internesting. Internesting female green turtles typically remain in shallow, nearshore waters up to 10 m deep (Pendoley, 2005). Internesting flatback turtles favour depths of <25 m, and foraging flatback turtles have been found to occur in waters shallower than 130 m (Whittock et al., 2016a and b). Loggerhead turtles and hawksbill turtles are generally found in shallower coastal areas (Bjorndal, 1996; Shigenaka, 2003) Therefore, it is considered unlikely that the deep, offshore waters at the outer extent of the habitat critical that overlap Operational Area 2 (water depths of 130 m to 400 m) represent important internesting or foraging habitat. Although individual turtles migrating, mating or foraging may occur within or adjacent to Operational Area 2, marine turtles do not use light cues to guide these behaviours. As such, light emissions from the vessels are unlikely to result in more than short-term, slight behavioural disturbance to isolated transient individuals. Short-term light emissions from the vessels are unlikely to result in displacement of adult turtles from internesting or nesting habitat critical to the survival of the species, or important behaviours for nesting adult turtles.

Seabirds and Migratory Shorebirds

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). Operational Area 2 may be occasionally visited by seabirds and migratory shorebirds. Although there is no emergent land that could be used for roosting or nesting habitat in Operational Area 2, North West Cape is 16 km from the boundary of it. Migratory shorebirds may be present in or fly through the region between July and December, and again between March and April as they complete migrations between Australia and offshore locations (Department of Environment, 2015). The risk associated with collision from seabirds attracted to the light is considered to be low, given the short duration of the activity in Operational Area 2. Based on the short duration and transient nature of the activities in Operational Area 2, impacts are expected to be limited to minor behavioural disturbance to isolated individuals, with no displacement from important habitat.

Operational Area 2 overlaps a foraging and breeding BIA for the wedge-tailed shearwater, and is 24 km from the Muiron Islands, which is a significant breeding site for this species (Cannel et al., 2019). Adult shearwaters are vulnerable to artificial lighting during the breeding cycle, when returning to and leaving the nesting colony to maintain nesting sites or forage. Foraging wedge-tailed shearwaters may be attracted to sources of light emissions to feed on fish drawn to the light, however, the species feeds predominantly during the day (Catry et al., 2009, Whittow 1997). Artificial light can also impact behaviour and adult nest attendance, or confuse shearwater species, resulting in injury or mortality via collision with structures (Cianchetti-Benedetti et al., 2018; Rodriguez et al., 2017). Shearwater fledglings are predominantly impacted by onshore lighting sources, which can over-ride sea finding cues and attract fledglings further inland, preventing them from reaching the sea (Mitkus et al., 2018; Telfer et al., 1987).

The breeding period for the wedge-tailed shearwater is from August to March, with peak incubation and chick rearing during November (Cannel et al., 2019). During this period, adults have were observed taking a combination of short (1–4 days) or long (6–30 days) foraging trips from the Muiron Islands towards the north-west (Cannel et al., 2019). Operational Area 2 is within an area that is regularly used for short distance foraging trips during chick rearing, however the peak of this foraging activity occurs during November, which does not overlap the planned timing of the activity (December – April). Impacts to wedge-tailed shearwaters is considered to be limited to minor behavioural disturbance to isolated transient individuals, not significant to the population's presence in important breeding and foraging habitat.

Other Marine Fauna

Lighting from ROV or vessel activities in Operational Area 2 may result in the localised aggregation of fish around the ROV or below the vessel. These aggregations of fish due to light are considered localised and temporary. Any long-term changes to fish species composition or abundance is considered highly unlikely. Any localised impacts to marine fish are not expected to impact on any commercial fishers in the area. Krill or plankton may also aggregate around the source of light. These aggregations of fish, krill or plankton would be confined to a small area and would only occur when the ROV is in use. Based on the short duration and localised nature of the activity, these aggregations are not expected to attract pygmy blue whales, humpback whales or whale sharks.

Summary of potential impacts to environmental values(s)

Light emissions from the project vessels will not result in an impact greater than slight, localised and temporary behavioural disturbance to fauna near Operational Area 2.

Demonstration of ALARP

Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[53]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Legislation, Codes and Standards (other than OPGGS Act)				
No additional controls identified				
Good Practice				
Variation of the timing of the Petroleum Activities Program to avoid peak turtle nesting periods (December to March)	F: Yes. Avoidance of turtle nesting periods is technically feasible, although not considered to be reasonably practicable. CS: Not considered – control not reasonably practicable	Negligible reduction in consequence given the duration and nature of the activity.	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice for minimal environmental benefit.	No
Professional Judgement – Eliminate				
Restrict the Petroleum Activities Program to daylight hours, eliminating the need for external work lights	F: No. Components of the Petroleum Activities Program cannot be safely completed within a 12-hour day shift. As such, the need for external lighting cannot safely be eliminated. CS: Not considered – control not feasible	Not considered – control not feasible	Not considered – control not feasible	No
Professional Judgement – Substitute				
Substitute external lighting with 'turtle friendly' light sources (reduced emissions in turtle visible spectrum)	F: Yes. Replacement of external lighting with turtle friendly lighting is technically feasible, although is not	The potential environmental consequence as ranked as no lasting effect; substituting for turtle friendly lighting	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice for minimal	No

[53] Qualitative measure

	considered to be reasonably practicable. CS: Significant cost sacrifice. Retrofitting all external lighting on the vessels would result in considerable cost and time expenditure. Considerable logistical effort to source enough inventory of the range of light types on board the vessels.	would provide negligible environmental gain given the short duration of the activity.	environmental benefit. The cost/sacrifice outweighs the benefit gained.	
Professional Judgement – Engineered Solution				
No additional controls identified				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the potential impacts from routine light emissions from project vessels within Operational Area 2 to be ALARP. This includes consideration of the intermittent nature of light emissions for the duration of the Petroleum Activities Program and the requirements for external lighting for safe operations. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that the temporary routine light emissions from project vessels in Operational Area 2 may result in impacts limited to slight temporary behavioural disturbance to fauna with no effects at a population level. This level of impact is not expected to displace species from important habitat. Habitat critical to the survival of the species within Operational Area 2 include internesting buffers for green, flatback and loggerhead turtles. BIAs within Operational Area 2 include internesting BIAs for flatback, green, hawksbill and loggerhead turtles and a foraging and breeding BIA for wedge-tailed shearwaters. Further opportunities to reduce the impacts have been investigated above. As demonstrated in **Section 6.8**, the residual impacts of routine light emissions from project vessels in Operational Area 2 are not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential impacts and the NLPG were taken into consideration during the impact evaluation. Therefore, Woodside considers standard operations appropriate to manage the impacts and risks or routine light emissions to a level that is broadly acceptable.

6.7.1.7 Routine Acoustic Emissions from Activities within Operational Area 2

Context	
Project Vessels – **Section 3.10** Helicopters – **Section 3.12**	Biological Environment – **Section 4.4**

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Generation of acoustic signals from project vessels (including DP systems) during normal operations within Operational Area 2						X		A	F	GP PJ	Broadly acceptable	N/A
Generation of atmospheric noise from helicopter transfers within Operational Area 2						X		A	F			

Description of Source of Impact

The RTM tow, placement and stabilisation activities are planned between December and April, a period of generally calmer sea states, and are expected to take around 15–20 days and three vessels (1x PIV for the duration, and 2x AHTs for the tow and sinking of RTM) to tow, place, stabilise and augment the RTM as an IAR on the seabed along with the placement of the purpose-built reef modules. Vessels and helicopters will generate noise both in the air and underwater, due to the operation of thrusters' engines, subsea activities, etc. This noise will contribute to and can exceed ambient noise levels which range from about 90 dB re 1 µPa (root square mean sound pressure level (RMS SPL)) under very calm, low wind conditions, to 120 dB re 1 µPa (RMS SPL) under windy conditions (McCauley, 2005).

Project Vessels and Operation of Dynamic Positioning System

The PIV and AHTs will generate noise both in the air and underwater within Operational Area 2, due to the operation of thruster engines, propeller cavitation, on-board machinery etc. The main source of noise from a DP vessel relates to using DP thrusters. McCauley (1998) measured underwater broadband noise equivalent to about 182 dB re 1 µPa at 1 m (rms SPL) from an activity support vessel holding station in the Timor Sea (in 110 m water depth); it is expected that similar noise levels will be generated by the intervention vessel, PIV and activity support vessels used for this Petroleum Activities Program.

Positioning Equipment

One transponder unit may be installed on the seabed for metrology and positioning. Transponders typically emit pulses of medium frequency sound, generally within the range 21 to 31 kHz. The estimated SPL would be 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al., 2017).

Transmissions are not continuous but comprise short (3–40 millisecond) 'chirps'. Transponders will not emit any sound when on standby. When required for general positioning, they will emit one chirp every five seconds (estimated to be required for four hours at a time). When required for precise positioning, they will emit one chirp every second (estimated to be required for two hours at a time). For installation of the RTM and modules for the IAR, the single transponder unit may be deployed to the seabed before replacing the RTM and will be recovered once activities are completed.

Helicopter Transfers

Helicopter activities may occur in Operational Area 2, including the landing and take-off of helicopters on the vessel helidecks. Sound emitted from helicopter operations is typically below 500 Hz (Richardson et al., 1985). 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).

Impact Assessment

Potential impacts to environmental values

Receptors

Operational Area 2 is located in waters about 130 m – 400 m deep. The fauna associated with this area will be predominantly pelagic species of fish, with migratory species such as turtles, whale sharks and cetaceans (**Section 4.4.3**) potentially present in the area seasonally (**Table 4-7**). As outlined in **Section 6.6.1.6**, noise interference is a key threat to a number of migratory and threatened cetaceans and marine turtles identified as occurring within Operational Area 2. Relevant recovery plans, threat abatement plans and conservation advice for these species are outlined in **Table 4-3**; **Section 6.8** assesses relevant actions and objectives from applicable plans to demonstrate the petroleum activities program is not inconsistent with these plans.

Operational Area 2 overlaps habitat critical to the survival of loggerhead, flatback and green turtles for internesting. Relevant BIAs within Operational Area 2 include the humpback whale migration BIA, pygmy blue whale migration BIA, and internesting BIAs for flatback, green, hawksbill and loggerhead turtles. As for within Operational Area 1, Pygmy blue whale individuals may occasionally transit Operational Area 2, with a higher likelihood of occurrence during April to August and October to January during their seasonal migrations. The possible foraging area BIA off North West Cape for this species is located >20 km from Operational Area 2. Although Operational Area 2 overlaps a humpback whale migration BIA, activities within Operational Area 2 will occur outside the humpback whale migration periods (July (northbound) and late August/September to October (southbound)). Therefore, no impacts to humpback whales are expected.

Marine turtle internesting peak seasons within the region of Operational Area 2 occur between October and May. Internesting female green turtles typically remain in shallow, nearshore waters up to 10 m deep (Pendoley, 2005). Internesting flatback turtles favour depths of <25 m, and foraging flatback turtles have been found to occur in waters shallower than 130 m (Whittock et al., 2016a and b). Loggerhead turtles and hawksbill turtles are generally found in shallower coastal areas (Bjorndal, 1996; Shigenaka, 2003) Therefore, it is considered unlikely that the deep, offshore waters at the outer extent of the habitat critical that overlap Operational Area 2 (water depths of 130 m to 400 m) represent important internesting or foraging habitat.

Potential Impacts of Noise

Potential impacts to cetaceans and marine turtles are outlined in **Section 6.6.1.6**.

Project Vessel Noise

Noise generated by the project vessels is expected to be limited to 182 dB re 1 µPa at 1 m (McCauley, 1998). The potential for received levels to exceed weighted thresholds defined for PTS or TTS for marine mammals is considered not credible due to propagation and reduction of sound from the source. Behavioural response thresholds for marine mammals are estimated to be exceeded out to about 7500 m from the project vessels on DP. Operational Area 1 is surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal's ability to avoid the activities. Project vessels will be within Operational Area 2 for a limited period of 15–20 days.

Considering the overlap with or proximity of BIAs to Operational Area 2, particularly at the IAR location, it is likely there may be increased numbers of individuals of pygmy blue whales (and other whale species) within Operational Area 2 during migratory periods. For pygmy blue whales there is unlikely to be overlap with peak migration in the proposed 2020/2021 weather window, however there may be overlap with their southern migration in the contingency 2021/2022 window. Operational Area 2 is located >20 km from the possible foraging area BIA for pygmy blue whales offshore from the Ningaloo Coast, and therefore no impacts are predicted to occur from project vessel noise on individuals foraging within this BIA. Given the timing of activities, humpback whales will not be present and therefore no impacts will occur for this species.

As described in **Section 6.6.1.6**, there are no quantitative sound exposure thresholds for behavioural responses in turtles resulting from continuous noise sources. Given water depths at the location of the IAR mean the area is unlikely to represent important internesting habitat for these species, therefore individuals are not expected to be in the area in high numbers even during nesting and internesting periods. As such, potential impacts to marine turtles from predicted noise levels are expected to be limited to behavioural impacts within a localised area around vessels. Other fauna associated with Operational Area 2 will be predominantly pelagic species of fish, with migratory species such as whale sharks and rays transiting through Operational Area 2 which may be similarly affected by noise from project vessels.

Compliance with EPBC Regulation 2000 – Part 8 Interacting with Cetaceans to reduce the likelihood of collisions with cetaceans may also further incidentally reduce the noise generated by vessels in proximity to cetaceans and marine turtles, as vessels will be travelling slower and slower vessel speeds may reduce underwater noise. In summary, potential impacts from vessel noise are likely to be restricted to temporary avoidance behaviour of individuals transiting through Operational Area 2 with no lasting effect. Individuals foraging or migrating may deviate slightly from their activities or migration route, but are expected to continue on their migration pathway or resume normal behaviours within a short proximity from the activities.

Positioning Equipment Noise

As described in **Section 6.6.1.6**, transponders used for positioning have the potential to cause some temporary behavioural disturbance to marine fauna out to 42 m from the source; however, noise levels will be well below injury thresholds. As a maximum of one transponder will be used at the proposed IAR location, and given the short duration chirps and the mid frequencies used by positioning equipment, the acoustic noise from a single transponder is unlikely to have a substantive effect on the behavioural patterns of marine fauna. Therefore, potential impacts from transponder noise are likely to be restricted to temporary (up to 20 days) and localised avoidance behaviour of individuals transiting through the Operational Area 2, and therefore are considered localised with no lasting effect.

Helicopter Noise

As described in **Section 6.6.1.6**, a negligible impact will occur to marine fauna from underwater noise from helicopters. Operational Area 2 may be occasionally visited by migratory and oceanic birds but does not contain any emergent land that could be used as roosting or nesting habitat. The closest emergent land is 16 km south (North West Cape). One BIA, a breeding area for wedge-tailed shearwaters, overlaps Operational Area 2 (August to April). Given the expected low density of seabirds within Operational Area 2 due to a lack of roosting or nesting habitat, the relative infrequency of helicopter flights and lack of lasting effect of potential behavioural responses to helicopter noise, impacts would be unlikely, localised and temporary, and result in no lasting effect.

Summary of Potential Impacts to Environmental Value(s)

It is considered that noise generated by the vessels, positioning transponders and helicopters will result in no greater than localised, short-term impacts to marine fauna with no lasting effect.

Demonstration of ALARP

Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[54]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Use dedicated Marine Fauna Observers (MFOs) on project vessels for the duration of the Petroleum Activities Program to watch for whales and provide direction on and monitor compliance with Part 8 of the EPBC Act Regulations.	F: Yes. However, activity vessel bridge crews already maintain a constant watch during operations in compliance with the Woodside Marine – Charterers Instructions, on the requirements of vessel and whale interactions. In the event of a cetacean (or other sensitive fauna) in close proximity to project vessels, it is unlikely that DP (the most significant source of underwater noise expected during the Petroleum Activities Program) will be deactivated given it is a safety critical requirement for project vessels to hold station. As such, an MFO implementing management / shut	Given that bridge crews already maintain a constant watch during operations, additional MFOs would not further reduce the likelihood or consequence of impact.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No

[54] Qualitative measure

	down zones is considered to be ineffective. CS: Additional cost of MFOs			
Undertake site-specific acoustic modelling	F: Yes it is feasible to undertake site-specific modelling, however, the generation of noise from these sources is already well understood and this noise cannot be eliminated due to operating requirements. CS: Additional cost of modelling	Given that noise cannot be eliminated due to operating requirements, modelling would not further reduce the likelihood or consequence of impact, noting that no activities of significant noise generation are proposed (i.e. explosives).	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Eliminate				
Elimination of noise from vessels or positioning equipment.	F: No. The generation of noise from these sources cannot be eliminated due to operating requirements. CS: Inability to conduct the Petroleum Activities Program. Loss of project.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Variation of the timing of the Petroleum Activities Program to avoid key ecological (whale migration, turtle nesting) periods.	F: Yes. Migration periods for cetaceans and BIAs that may occur in the Operational Area (pygmy blue and turtles) are well defined. Timing of all activities is currently not determined within the operational window, and due to operational requirements and conflicting seasonal windows, conducting activities during migration/ nesting seasons may not be able to be avoided. CS: Potentially significant.	Avoiding migration periods or BIA seasonality would reduce the likelihood of impacts to cetaceans and/or turtles. However, given that the Predicted noise levels are not considered to be ecologically significant at a population level, the overall benefit is minimal.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				

ALARP Statement
On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the potential impacts from noise generated from project vessels and helicopters to be ALARP. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability
Acceptability Statement
The impact assessment has determined that, given the adopted controls, routine acoustic emissions from project vessels is unlikely to result in a potential impact greater than localised behavioural impacts not significant to marine fauna, and with no lasting effect. Habitat critical to the survival of the species within Operational Area 2 include internesting buffers for green, flatback and loggerhead turtles. BIAs within Operational Area 2 include the humpback whale migration BIA, pygmy blue whale migration BIA, internesting BIAs for flatback, green, hawksbill and loggerhead turtles, and a breeding BIA for the wedge-tailed shearwater. Further opportunities to reduce the impacts and risks have been investigated above. As demonstrated in **Section 6.8**, the residual impacts of routine acoustic emissions from project vessels in Operational Area 2 are not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans. Regard has been given to relevant conservation advice during the assessment of potential impacts. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of these acoustic emissions to a level that is broadly acceptable.

6.7.1.8 Routine and Non-routine Atmospheric Emissions from Activities within Operational Area 2

Context	
RTM Activities – **Section 3.7** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3**

Impacts and Risks Evaluation Summary												
	Environmental Value Potentially Impacted							*Evaluation*				
Source of Impact	***Soil and Groundwater***	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Consequence***	***ALARP Tools***	***Acceptability***	***Outcome***
Exhaust emissions from internal combustion engines and incinerators on project vessels within Operational Area 2				X				A	F	LCS GP PJ	Broadly acceptable	EPO 8

Description of Source of Impact
It is expected to take around 15–20 days and three vessels (1x PIV for the duration, and 2x AHTs for the sinking of RTM) to tow, place, stabilise and augment the RTM as an IAR on the seabed along with the placement of the purpose-built reef tower modules. ***Internal combustion engines and incinerators*** Atmospheric emissions will be generated by the project vessels from internal combustion engines (including all equipment and generators) during the Petroleum Activities Program. Emissions will include SO_2, NO_x, ozone depleting substances, CO_2, particulates and volatile organic compounds (VOCs).

Impact Assessment
Potential impacts to environmental values
Fuel combustion has the potential to result in localised, temporary reduction in air quality. Potential impacts include a localised reduction in air quality, generation of dark smoke and contribution to greenhouse gas emissions. Given the short duration and exposed location of project vessels (which will lead to the rapid dispersion of the low volumes of atmospheric emissions), the potential impacts are expected to be localised and of no lasting effect.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that the release of a small volume of greenhouse gases will not result in a potential impact greater than a temporary impact to local air quality with no lasting effect.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[55]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Marine Order 97 (Marine Pollution Prevention – Air Pollution).	F: Yes CS: Minimal cost	Legislative requirements to be followed may slightly	Control based on legislative requirements – must be adopted	Yes C 8.1

[55] Qualitative measure

		reduce the likelihood of air pollution.		
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the potential impacts of release of atmospheric emissions within Operational Area 2. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, atmospheric emissions during the Petroleum Activities Program will not result in a potential impact greater than a temporary decrease in local air quality with low impact to the environment or human health and no lasting effects. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of the described emissions within Operational Area 2 to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 8 Fuel combustion emissions and incineration during the Petroleum Activities Program will be in compliance with marine order requirements to restrict emissions to those necessary to perform the activity.	**C 8.1** Refer to **Section 6.6.1.7**	**PS 8.1** Refer to **Section 6.6.1.7**	**MC 8.1.1** Refer to **Section 6.6.1.7**.

6.7.2 Unplanned Activities (Accidents, Incidents, Emergency Situations)

6.7.2.1 Unplanned Discharge: Release of Plastics

Context	
RTM – **Section 3.5.1** RTM Activities – **Section 3.7**	Physical environment – **Section 4.3** Biological environment – **Section 4.4**

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***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Accidental release of polyethylenes, PVC and polypropylenes to the marine environment within Operational Area 2		X	X		X		X	B	E	1	L	LCS GP PJ CV SV	Broadly acceptable	EPO 19 and 20
Accidental release of polyurethanes (bend stiffener and foam) to the marine environment within Operational Area 2		X	X		X		X	B	E	1	L			

Description of Source of Risk

Polyethylenes, PVC, polypropylenes

Plastic-coated electrical cabling and chemical lines on the RTM topsides will be removed to an estimated <10 kg of residual plastics in electrical cabling, insulation, chemical lines, valves and gauges. These materials are comprised of a variety of plastics, primarily polyethylenes, polyvinyl chloride (PVC) and polypropylenes. Most of these materials are sealed within the structure/ topsides of the RTM, with limited potential exposure to seawater.

The risers and EHU will be removed from the RTM once it is on the seabed at the proposed IAR location (within Operational Area 2). However, there is a possibility that one of the risers may become stuck within the RTM, if a j-tube is damaged during placement and may not be able to be removed. In this risk assessment the worst-case scenario has been evaluated – i.e. it has been assumed that the largest of the risers (9" [ID] production riser) remains *in-situ*. The risers are constructed from multiple layers of stainless steel and plastics, with the plastics comprised of high-density, crosslinked polyethylene (XLPE), polypropylene and Kevlar tape (minor component). The total weight of the 9' production riser (including steel) is 14.6 tonnes, with the plastic component comprising 3.3 tonnes.

Polyurethanes (foam and bend stiffeners)

Currently compartment 13 of the RTM contains approximately 65 m^3 of polyurethane foam (volume at sea level). Compartment 13 is still structurally sound so it can be assumed that the foam contained within this compartment is still intact and in good condition. If the foam were to stay inside this compartment following RTM placement on the seabed, it would pose no risk to the environment. However, over time the outer walls of Compartment 13 will corrode and the compartment will flood and potentially release the foam. To prevent this from occurring, once the RTM is on the seafloor, compartment 13 will be flooded and grout will be injected into the compartment to fully encapsulate the foam. It is estimated that the foam will have compressed to approximately 10% of its original volume (~6.5 m^3) due to external water pressure (1600 kPa, based on a water depth of 148 m below LAT), creating a void space that will be filled with grout. The grout to be used is a combination of general-purpose cement and water. This is the same type of cement that is used in the fabrication of the purpose-built concrete modules.

Over time as the steel outer walls of compartment 13 corrode, the inner grout/foam matrix may become exposed. The foam/grout matrix would then be populated by marine growth. Once exposed, there is however a risk that degradation of the grout could result in an accidental release of the polyurethane foam.

It is planned that the risers will be fully removed, but there is potential for a small length (<0.5 m) of bend stiffener plastic material to remain for each of the seven risers, due to limitations with ROV access. The bend stiffeners are conically shaped polyurethane mouldings around the risers that are designed to add local stiffness to the riser and limit the bending stresses and curvature to acceptable levels. Approximately 2.7 m^3 of bend stiffener would remain and these remnant pieces will be encased in grout. Over time, degradation of the grout could expose these pieces of the bend stiffeners.

Impact Assessment

Potential impacts to environmental values

Corrosion and breakdown of the RTM left in-situ

As described in **Section 6.7.1.3**, once the sacrificial anodes have been exhausted, the RTM external steel surface will start to degrade via erosion and corrosion. Erosion can be considered negligible as a low flow rate around the structure is expected, and additionally, the metal surfaces of the structure would be shielded from direct impaction by marine growth and the coating system. Corrosion would be expected to occur due oxidisation and corrosion due to microbial action, both of which would be localised to the areas exposed due to the imperfections in the coating system. At these points of imperfection, based on the materials involved, water depth and temperature, corrosion is likely to be a relatively slow process, and would be expected in the order of 0.1–0.2 mm/year (Reinhart and Jenkins, 1972). This slow rate is also due to the structures colonising with marine growth over time, providing the structure with natural protection from corrosion.

At a corrosion rate of 0.1–0.2 mm/year, the structure will take between 100 and 400 years (beyond the degradation of the coating system) to corrode and fully degrade.

Degradation of the grout

The grout that will be used for encapsulation of the foam and the remnant pieces of bend stiffener is a mixture of water and cement (i.e. concrete). Concrete exposed to seawater may deteriorate from the combined effects of chemical and physical processes, including: sulphate attack; leaching of lime (calcium hydroxide); alkali-aggregate expansion; and erosion and abrasion from waves. Once the grout is injected into the void space around the compressed foam in compartment 13 and hardens, it will only be susceptible to chemical rather than physical degradation. Similarly, the grout encasing the remnant pieces of bend stiffener could degrade (primarily via chemical processes).

Magnesium sulphate present in seawater reacts with the calcium hydroxide in the cement and forms calcium sulphate, as well as magnesium hydroxide precipitation. Magnesium sulphate also reacts with hydrated calcium aluminate in cement and forms calcium sulfo-aluminate. These final formations are the primary reasons for chemical attack on concrete structures. The lime content present in concrete is also lost due to leaching, particularly as calcium hydroxide and calcium sulphate are both soluble in seawater.

The primary products of chemical degradation of grout (calcium sulphate, magnesium hydroxide) are included on the PLONOR list (List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment) (OSPAR, 2019).

It is expected that the grout encapsulating the foam and the remnant pieces of bend stiffener will degrade over a timeframe of approximately 10–50 years. The rate of degradation would be further decreased as any grout exposed to seawater (i.e. as the wall of compartment 13 corrodes and breaks down) is colonised by marine growth.

Degradation of the plastics

The foam in compartment 13 will be separated from direct exposure to the surrounding waters by both primary (steel walls of the RTM) and secondary (grout encapsulation) containment. The remnant pieces of bend stiffener will be separated from direct exposure to the surrounding waters by primary containment (grout encapsulation). As outlined above, any degradation of the steel walls of the RTM and of any exposed grout will be inhibited by marine growth, and potentially also by burial in sediments. Therefore, exposure of the foam and the bend stiffeners to seawater will only occur over very long timeframes (hundreds to thousands of years).

Plastics have a variety of degradation mechanisms in the environment, including:

- Ultraviolet light
- thermal ageing
- weathering
- chemical degradation
- ionizing radiation
- creep, fatigue and environmental stress cracking
- biological degradation.

<u>Polyethylenes, PVC, polypropylenes</u>

Over time the residual plastics in electrical cabling insulation, chemical lines, valves/gauges, and any remnant lengths of riser within the RTM may be exposed as the steel structure of the RTM degrades. The timeframes and extent of this will be influenced by the degree of biofouling on exposed surfaces of the RTM and the rate of breakdown of the steel structure (see above).

There are no credible mechanisms for physical degradation of these plastics, and any chemical degradation would be extremely slow, and is not likely to result in the release of any toxic plastic additives. Plastics such as polyethylenes, PVC and polypropylenes are inert materials that are, in general, non-susceptible to biodegradation. Polyethylene is one of the synthetic polymers of high hydrophobic level and high molecular weight, and is not biodegradable. This is particularly the case for high-density, crosslinked polyethylenes such as XLPE, which would only biodegrade over extremely long timeframes (hundreds to thousands of years). Similarly, PVC and polypropylene are rigid plastics that resists abrasion and chemicals, have low moisture absorption, and are non-biodegradable (unless manufactured with a degradable polymer additive).

Any degradation of the residual plastics in electrical cabling insulation, chemical lines, valves/gauges, and any remnant lengths of riser within the RTM would be limited chemical degradation (hydrolysis, oxidation) over very long time frames (potentially hundreds to thousands of years). Given the limited quantities of these residual plastics, and the extremely slow rate of degradation, no substantial decline in water or sediment quality is likely to occur. Consequently, no significant impacts are likely to occur to any sensitive receptors near the RTM (e.g. sediment macrofauna/infauna; benthic habitats/fouling communities; benthic fish assemblages; demersal and pelagic fishes targeted by recreational and commercial fishers).

Polyurethanes (foam and bend stiffeners)

Over time, the steel outer walls of compartment 13 of the RTM are expected to corrode and break down, revealing the grout and foam matrix inside the compartment. Physical and chemical degradation of the grout could expose the polyurethane foam, which could also undergo physical and chemical degradation, potentially releasing pieces of foam to the environment where the contaminants could impact sensitive receptors. Similarly, degradation of the grout encasing the remaining pieces of the bend stiffeners could expose this material, which could physically and chemically degrade and release plastic as a contaminant into the marine environment.

Composition of the foam and bend stiffeners

During fabrication of the RTM, a polyurethane foam was injected into compartment 13 to provide buoyancy to the compartment, if it were to flood due to due to damage or leaks. The product (MB 163P) was a two part polyurethane system that is comparable to expanding foams used for a variety of construction purposes, including gap/cavity filling. Polyurethane foams are formed by the reaction between an isocyanate prepolymer and a polyol in the presence of a blowing agent, and an amine (catalyst). In MB 163P, the isocyanate is polymeric methylene diphenyl diisocyanate (PMDI) and the polyol is either ester-based or ether-based with terminal hydroxyl groups. The blowing agent is carbon dioxide, which is formed as a by-product of the reaction between water and isocyanate (accelerated by the catalyst). During the foaming process, there are two reactions occurring simultaneously, namely, the reaction between the isocyanate and polyol (gelation) to form the polymer network and the reaction between the isocyanate and water (blowing), resulting in the foam. When the reaction is fully complete, the foam forms a hard matrix that encapsulates the gas bubbles.

The polyol component of MB 163P also includes a flame retardant; however, no information is available in the product Safety Data Sheet as to what chemical is. Polybrominated diphenyl ethers (PBDEs), which are classified as persistent organic pollutants (POPs), were often used as flame retardants in the manufacture of polyurethane foams (Gallo et al., 2018). PBDEs are global contaminants of concern because they are persistent and toxic, and can bioaccumulate and biomagnify. PBDEs tend to be stable and persistent in nature and are often associated with soils and sediments due to their high hydrophobicity and relatively low volatility. However, air and water particulate phases constitute important transport media for the dispersion of these contaminants and any congeners have been found to accumulate in living organisms and biomagnify in food chains (Yogui and Sericano, 2009; Lee and Kim, 2015).

It is estimated that the flame retardant could potentially comprise ~2% of MB 163P, based on the typical concentration of flame retardants in other polyurethane foams, and on an assumption that the polyol component represents 50% of the two part mixture. The foam has a density of 90 kg/m^3, which means that the 65 m^3 of foam in compartment 13 could contain approximately 110–120 kg of flame retardant.

The bend stiffener material is also a two part polyurethane system, with an ether-based polyol component, and an isocyanate. Both the foam and the bend stiffeners are formed from the same primary components, with the main difference being that there is no catalyst (amine) or flame retardant used in the formulation of the polyurethane bend stiffeners, and the bend stiffeners have a higher density given a blowing agent was not used.

Physical / chemical degradation of the foam and bend stiffeners

Physical degradation of the foam and bend stiffeners would result in breakdown to mesoplastic (~5–20 mm), large microplastic (~1–5 mm), small microplastic (~20–999 μm), and nanoplastic (<1 μm) sized pieces.

Ultraviolet light contribution to degradation of the foam and bend stiffeners is expected to be negligible because the levels of ultra-violet light are extremely low at 150 m water depth. Similarly, thermal ageing will not contribute significantly to foam/bend stiffener breakdown given that the ambient seawater temperatures are relatively moderate. If the primary (steel compartment) and secondary (grout) containment of the foam are removed, some weathering of the foam may take place due to sediment transport / scour. However, this is expected to be minimal and is not considered to be a significant driver for foam breakdown. Similarly, if the primary containment for the bend stiffeners (grout) is removed, some weathering could take place, but again this is not likely to contribute significantly to break down.

Any exposed foam/bend stiffener would be susceptible to a degree of biofouling, which would slow the degradation process by shielding of any exposed material from scour or other mechanical abrasion.

When fully reacted, polyurethane foams and rigid products (i.e. the bend stiffeners) are highly stable and largely chemically inert in seawater (i.e. only soluble in organic solvents). The main degradation pathways for polyurethanes are a combination of hydrolysis, thermal oxidation and/or photo-oxidation. It has been demonstrated that hydrolysis predominates for polyester-based polyurethane PU(ES), whereas oxidation is the principal cause of degradation for polyether-based polyurethane PU(ET) (Lattuati-Derieux et al., 2011). Polyurethane foams degrade more rapidly than other forms of polyurethanes because they are very porous, and this porosity makes the polymer accessible to environmental oxygen, light and moisture. The degree of degradation appears to be dependent on the degree of crosslinking – PU(ES) undergoes relatively fast hydrolysis even at low temperatures in water (and consequently are generally not used for long-term seawater applications); whereas PU(ET) degrade much more slowly.

It is not known whether the polyol used in MB 163P is ester-based or ether-based. The product is no longer marketed and the available Safety Data Sheet does not provide any information on the polyol used for the reaction. It is believed that MB 163P is a PU(ET) rather than a PU(ES), as the polyol used is probably polyether or poly(ethylene oxide), similar to most two-part expanding foams currently in use. The polyol used in formulation of the bend stiffeners is a polyether. Consequently, hydrolysis is unlikely to be a significant driver for the foam or bend stiffener breakdown, and any oxidation is likely to be very slow given the relatively low and constant water temperatures (i.e. little or no thermal oxidation will occur).

Ionizing radiation only occurs when a polymer is exposed to radioactive materials of sufficiently high intensity to cause chain scission (e.g. high-level radioactive waste materials). This is not a realistic scenario for the foam or bend stiffeners. Creep is the tendency of a solid material to deform permanently under the influence of mechanical stresses, which can occur as a result of long-term exposure to high levels of stress that are still below the yield strength of the material. Creep is not a credible degradation scenario for the foam or bend stiffeners, since they will not be subjected to high levels of stress. Similarly, foam or bend stiffener degradation due to fatigue is not considered credible considering that there will be no temperature or pressure-induced cyclic stress (i.e. expansion/contraction).

Overall, the most credible mechanism for breakdown of the foam and bend stiffeners once released from grout containment is a degree of chemical degradation via oxidation. However, any oxidation is likely to be very slow given the relatively low and constant water temperatures.

Biodegradation of the polyurethanes (foam and bend stiffeners)

Despite its xenobiotic origins, polyurethane has been found to be susceptible to biodegradation by naturally occurring microorganisms (Howard 2002). It has been established that the biodegradation of polyurethanes depends on their chemical structure, which is conditioned by several factors such as the nature of the polyol used in formulation. The urethane bond in polyurethane has been reported to be susceptible to microbial attack (Shah et al., 2008). PU(ES) are more prone to microbial degradation due to the presence of ester bonds that are known to be hydrolysable via enzymes (Krasowska et al., 2015). In general, PU(ES) will biodegrade more readily than PU(ET), with highly crosslinked poly(ether-urethanes) found to be more resistant to biodegradation than slightly crosslinked poly(ester-urethanes). Studies in the Baltic Sea indicated that crosslinked poly(ether-urea-urethane) is very resistant to degradation in seawater (Rutkowska et al., 2002).

Three types of polyurethane degradations have been identified in the literature: fungal biodegradation, bacterial biodegradation and degradation by polyurethanase enzymes (Howard, 2002). Under aerobic conditions, aerobic microorganisms (bacteria and fungi) are mostly responsible for the degradation of polymers. Microorganism biomass, carbon dioxide, and water are the final products of degradation. Under anoxic conditions, anaerobic microorganisms play the main role in polymer degradation, and the primary products are methane, water, and biomass (Shah et al., 2008; Krasowska et al., 2015).

It is expected that the polyurethane foam and bend stiffeners will be very resistant to biodegradation. If the foam or bend stiffeners are exposed to seawater due to breakdown of the grout some degree of degradation may occur over long periods of time. However, the primary products of this biodegradation will be benign (microbial/fungal biomass, CO_2, water).

Potential impacts to water quality, ecosystems / habitats

There is no credible mechanism for extensive physical or chemical degradation of the polyurethane foam and bend stiffeners if the grout containment breaks down over time. Therefore, it is not expected that the foam and bend stiffeners will physically break down into either larger pieces (macroplastics), or into meso- or microplastic sized pieces that could be ingested by benthic biota such as invertebrates and fishes. If any larger pieces of foam break away from the foam/grout matrix they would be negatively buoyant (due to compression of the foam via hydrostatic pressure), and so would sink to the seabed. Similarly, if any larger pieces of the bend stiffeners break way (and this is highly unlikely to occur) these pieces would be negatively buoyant due to the density of this material. There are no credible mechanisms for these larger pieces to be broken down in to meso- or microplastics.

Any biodegradation of the foam and bend stiffeners would only occur over long periods of time. Although the primary products of this process may result in a temporary, localised alteration in water quality and/or sediment quality, this is not likely to cause any significant impacts to sensitive receptors near the RTM (e.g. sediment macrofauna/infauna; benthic habitats/fouling communities; benthic fish assemblages; demersal and pelagic fishes targeted by recreational and commercial fishers).

Potential impacts to protected species, values of the Ningaloo Coast WHA / AMP, KEFs and social values

Any physical or biological degradation of the polyurethane foam and bend stiffeners will not result in the release of contaminants that could potentially become bioavailable and bioaccumulate in any protected species that use the

waters near the RTM disposal location (e.g. pygmy blue whales, marine turtles, whale sharks, seabirds). Any decline in water quality from degradation of the foam and bend stiffeners will not impact on any physical or ecological values of the Ningaloo Coast World Heritage Area, the Ningaloo AMP, or of any KEFs in the region. Similarly, any degradation of the foam and bend stiffeners will not impact on any of the social values of the RTM disposal location, or of the adjacent World Heritage Area and AMP.
Summary of potential impacts to environmental values(s)
Given the adopted controls, it is considered that breakdown of polyurethane foam and bend stiffeners in the RTM and release of biodegradation products to the marine environment will not result in a potential impact to water quality greater than temporary contamination above background levels, quality standards or known effect concentrations that is negligible and will not result in a potential impact greater than negligible and temporary disruption to a small proportion of biological populations with no impact on critical habitat or activity.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[56]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Approval of an artificial reef permit under the Sea Dumping Act, which ensures the following (DAWE, 2008): • an appropriate site has been selected • the materials are suitable and prepared properly • no significant adverse impact on the marine environment occurs • the reef does not pose a danger to navigation, fisherman or divers • the artificial reef is charted on maritime maps.	F: Yes CS: Minimal cost. Standard practice.	Artificial reef permit application process ensures that the proposal for the IAR is environmentally acceptable and that the IAR will serve a purpose (DAWE, 2008).	Control based on legislative requirements – must be adopted.	Yes 19.1
Good Practice				
Ongoing, regular surveys of the IAR	F: Yes. CS: Moderate cost.	Long term monitoring of the IAR will be performed by Recfishwest, as required under the artificial reef permit. This is described in **Section 7.5.4**.	Control based on legislative requirements – must be adopted.	Yes 19.2
Professional Judgement – Eliminate				
Remove flexible risers and EHU from RTM	F: Yes. Feasible if risers are removed once RTM is on the seabed. CS: Significant cost.	Reduction in environmental impact and stakeholder concern associated with degradation of 14.6 tonnes of plastics over time.	Benefits outweigh cost/sacrifice.	Yes C 22.4

[56] Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[56]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Remove riser bend stiffeners as close as possible to bottom of RTM	F: Yes. Feasible to cut bend stiffeners using ROV CS: Moderate cost	Reduction in environmental impact and stakeholder concern from degradation of 6.2 to 9 tonnes of plastics. Due to access at bottom of RTM, up to 0.5 m of riser bend stiffener may remain in place following cutting of bend stiffener using ROV.	Benefits outweigh cost/sacrifice.	Yes C 22.5
Remove residual plastics from RTM topsides, including bulk electrical cabling and chemical lines	F: Yes. Significant portion of plastics can be removed from topside including electrical cabling and chemical lines. CS: Reasonable cost, but acceptable.	Reduction in environmental impact and stakeholder concern from degradation of plastic over time.	Benefits outweigh cost/sacrifice.	Yes C 22.6
Remove foam from Compartment 13	F: Physically removing foam from compartment 13 with the RTM moored would require a minimum of 7 people due to confined space entry safety requirements, which exceeds the number of people allowed on RTM under the Safety Case. Recent Woodside experience of foam removal from an RTM ballast compartment took 2 months. This was in a situation where confined space entry could be undertaken with the required number of people and the foam was foam batts, which was easier to remove than expanded foam, which would require a method to break up for removal. Even if a	Not considered – control not feasible	Not considered – control not feasible	No

Demonstration of ALARP				
Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[56]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
	confined spaced entry was able to be undertaken on NGA RTM, given personnel and equipment access limitations and the expandable foam, it would be expected to take significantly longer than 2 months. Given limitations on confined space entry this is not considered feasible. F: Foam removal from compartment 13 with the RTM moored would require a minimum of 7 people due to confined space entry safety requirements, which exceeds the number of people allowed on RTM under the Safety Case, given emergency egress limits for the RTM. Recent Woodside experience of foam removal from an RTM ballast compartment took 2 months. This was with FPSO connected (able to undertake confined space entry with minimum 7 people) and the foam was foam batts (easier to remove than expanded foam, which would require a method to break up for removal). Even if a confined spaced entry was able to be undertaken on NGA RTM, given personnel and equipment access limitations and the expandable foam, it			

Demonstration of ALARP				
Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[56]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
	would be expected to take significantly longer than 2 months. Given confined space entry limitations this is not considered feasible. CS: Control not feasible.			
Chemically dissolve foam	F: Dissolution of foam with acid could potentially be conducted using ROV. The volume of acid required to dissolve foam in the 65 m^3 compartment would likely be approximately three times the volume of the compartment volume (195 m^3/ 195,000 L), which would require a dedicated vessel. Foam could be injected using the access pipe into the compartment, however this would rely on contacting the 65 m^3 of foam using one access point, and would require multiple iterations of pumping acid into the compartment and recovering the dissolved acid/ foam mixture, which would take approximately 1 week. Due to the location of the access pipe to the compartment, recovering all the acid and foam would be difficult and its expected that approximately 20–30% of the acid and foam would remain in the compartment (19,500 L of acid	Approximately 70% of foam removed, however requires handling of large volume of acid with associated environment and health and safety risks. Would also require disposal of large volume acid/ foam mixture. Removal of 70–80% of foam. This requires using and disposing of a large volume of acid, with associated environment and health and safety risks.	Due to the large volume of acid required and associated environment and health and safety risks, along with the residual acid and foam that would remain in the compartment, the benefits do not outweigh the cost.	No

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[56]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
	and 1.95 tonnes of foam). F: Dissolution of foam with acid could potentially be conducted using ROV, with the RTM on the seabed. The volume of acid required to dissolve foam in the 65m^3 compartment would likely be approximately 3 times the volume of the compartment volume (195m3/ 195,000l), which would require a dedicated vessel. This could be done using the access pipe into the compartment, however this would rely on contacting the 65m3 of foam using one access point, with multiple iterations of pumping acid into the compartment and recovering the dissolved acid/ foam mixture, which would take approximately 1 week. Due to the location of the access pipe to the compartment, recovering all the acid and foam would be difficult and its expected that approximately 20–30% of the acid and foam would remain in the compartment (up to 19,500l of acid and 1.95 tonnes of foam). CS: significant cost			
Cut compartment 13 from RTM whilst on seabed	F: Diamond wire cutters are used to cut marine structures and could potentially be used	Removes foam from RTM. Some seabed impact associated with cutting.	Given the fact that equipment of the required size and capacity does not exist,	No

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[56]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
	to cut compartment 13 from the RTM once on the seabed. The largest existing diamond wire cutter identified was approximately 5 m diameter. The RTM has a diameter of 8.5 m, so while the technology exists, the size and capacity does not. A new cutter could potentially be constructed; however, this would have a long lead time (6–9 months). Removing the compartment would be complex and would require removing the RTM access steel framework (including ladders) and other external equipment on seabed to reduce the effective diameter to 8.5 m, before using the cutter. CS: Significant cost		and would have a significant lead time and cost, this is not considered practicable.	
Cut out compartment 13 while on seabed	F: Diamond wire cutters are used to cut marine structures and this method has been considered for cutting compartment 13 from the RTM once on the seabed. The largest existing diamond wire cutter identified was approximately 5 m diameter. The RTM has a diameter of 8.5 m, so while the technology exists, the size and capacity does not. A new cutter could potentially be constructed;	Foam would be removed. Some seabed impact associated with use of cutting equipment.	Given equipment of the required size and capacity does not exist, and would have a significant lead time and cost, this is not considered practicable.	No

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)**[56]	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
	however this would have a long lead time (6–9 months). Removal of the compartment would be complex and would require the removal of RTM access steel framework (including ladders) and other external equipment on seabed to reduce the effective diameter to 8.5 m, before using the cutter. CS: Significant cost			
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Encapsulate compressed foam in grout	F: Yes. Foam predicted to compress to 10% of volume of compartment, enabling void space to be filled with grout, encapsulating the foam. CS: Reasonable cost.	Isolate foam from the marine environment significantly reducing likelihood of harm from degraded foam.	Benefits outweigh cost/sacrifice.	Yes C 22.7
Encapsulate any remaining bend stiffener that cannot be cut using ROV in grout	F: Yes. Bend stiffeners can have a mould created to enable the remnant stub to be encapsulated in grout. CS: Reasonable cost.	Isolate bend stiffeners from the marine environment significantly reducing likelihood of harm from degraded plastic.	Benefits outweigh cost/sacrifice.	Yes C 22.8

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 from release of plastics from the RTM. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability
Acceptability Criteria and Assessment
Principles of ESD The impact and risk evaluation has taken into account the following relevant principles of ESD: • decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations; • the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations; and • the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. **Internal Context** The Petroleum Activities Program is consistent with Woodside corporate policies, culture, processes, standards, structure and systems as outlined in the Demonstration of ALARP and Environmental Performance Outcomes, including: • Woodside Health, Safety, Environment and Quality Policy (**Appendix A**) • Woodside Risk Management Policy (**Appendix A**). **External Context** During stakeholder consultation with relevant persons, a number of stakeholders raised concerns about the potential impacts from residual contaminants (such as plastics) within the RTM that will not be removed as part of the offshore re-use/repurposing disposal option. Woodside has responded to all correspondence received from relevant persons. The merits of any objection or claim about leaving quantities of plastics within the RTM have been assessed (**Appendix F**). **Other Requirements** As demonstrated in **Section 6.8**, the residual risk of accidental release of plastics from the RTM is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks. There are no additional legislative requirements that apply.
Acceptability Statement The impact assessment has determined that, given the adopted controls, accidental release of plastics to the marine environment from the RTM represents a low risk rating that is unlikely to result in a potential impact above negligible, short-term impact on species, habitat (but not affecting ecosystems function), physical or biological attributes. 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. As demonstrated in **Section 6.8**, the residual risk of accidental release of plastics from the RTM is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these unplanned discharges to a level that is acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 19 Repurposing of the RTM as an IAR will comply with the requirements of the Sea Dumping Act.	**C 19.1** Refer to **Section 6.7.1.1**.	**PS 19.1** Refer to **Section 6.7.1.1**.	**MC 19.1.1** Refer to **Section 6.7.1.1**.
	C 19.2 Refer to **Section 6.7.1.1**.	**PS 19.2** Refer to **Section 6.7.1.1**.	**MC 19.2.1** Refer to **Section 6.7.1.1**.
			MC 19.2.2 Refer to **Section 6.7.1.1**.
EPO 22 No impacts to the marine environment from the long-term degradation of the RTM greater than a	**C 22.4** Refer to **Section 6.7.1.3**.	**PS 22.4** Refer to **Section 6.7.1.3**.	**MC 22.4.1** Refer to **Section 6.7.1.3**.
	C 22.5 Refer to **Section 6.7.1.3**.	**PS 22.5** Refer to **Section 6.7.1.3**.	**MC 22.5.1** Refer to **Section 6.7.1.3**.
	C 22.6	**PS 22.6**	**MC 22.6.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
consequence level of E[57].[58]	Refer to **Section 6.7.1.3**.	Refer to **Section 6.7.1.3**.	Refer to **Section 6.7.1.3**.
	C 22.7 Refer to **Section 6.7.1.3**.	**PS 22.7** Refer to **Section 6.7.1.3**.	**MC 22.7.1** Refer to **Section 6.7.1.3**.
	C 22.8 Refer to **Section 6.7.1.3**.	**PS 22.8** Refer to **Section 6.7.1.3**.	**MC 22.8.1** Refer to **Section 6.7.1.3**.

[57] Defined as 'Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

[58] Once installed to design specifications outlined in the artificial reef permit, ownership of the IAR will transfer to the WA State Government (DPIRD) under monitoring and management by Recfishwest (**Section 1.10.1.3**). In the unlikely event that adaptive management is required, this will be undertaken under by the State/Recfishwestwith oversight from DAWE. **Section 7.5.4** outlines long-term monitoring commitments which will be commited to as part of the artificial reef permit.

6.7.2.2 Unplanned Hydrocarbon Release: Vessel Collision within Operational Area 2

Context		
RTM – **Section 3.7** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4** Socio-economic – **Section 4.5** Values and Sensitivities – **Section 4.6**	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***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Loss of hydrocarbons to marine environment due to a vessel collision in Operational Area 2 (e.g. activity support vessels or other marine users)			X		X	X	X	A	D	1	M	LCS GP PJ RBA	Broadly acceptable	EPO 2, 3 and 12

Description of Source of Risk

Background

The temporary presence of the project vessels (1 x PIV and 2 AHT support vessels) in Operational Area 2 may result in a navigational hazard for commercial shipping within the immediate area (as discussed in **Section 6.7.1.4**). Vessels are likely to be in Operational Area 2 for between 15 and 20 days. This navigational hazards could result in a third-party vessel colliding with the AHT, RTM or support vessels.

Vessels are likely to have multiple isolated fuel tanks distributed throughout the hull of the vessel. Individual fuel tanks on a PIV are typically less than 500 m³ and up to 400 m³ for support vessels; however for the purposes of a conservative indication of the risks associated with a vessel collision for the IAR installation activities, Woodside has assumed a largest marine diesel tank volume of 500 m³.

In the highly unlikely event of a collision involving a vessel during the IAR installation activities, the vessels have the capability to pump fuel from a ruptured tank to a tank with spare volume so as to reduce the potential volume of fuel released to the environment. Project vessels will use marine diesel fuel.

Industry Experience

Refer to **Section 6.6.2.4**

Credible Scenario

For a vessel collision, in Operational Area 2, to result in the worst-case scenario of a hydrocarbon spill from the vessel potentially impacting an environmental receptor, several factors must align:

- The identified causes of vessel interaction must result in a collision.
- The collision must have enough force to penetrate the vessel hull.
- The collision must be in the exact location of the fuel tank.
- The fuel tank must be full, or at least of volume which is higher than the point of penetration.

The 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. Given the water depths of Operational Area 2 (between 130 m and 400 m), vessel grounding is not considered a credible risk.

The environmental risk analysis and evaluation identified and assessed a range of potential scenarios that could result in a loss of vessel structural integrity resulting in damage to fuel storage tank(s) and a loss of marine diesel to the marine environment (summarised in **Table 6-13**). The worst case scenario considered was a collision between the installation vessel and a third-party vessel (i.e. commercial shipping, other petroleum-related vessels and commercial fishing vessels). This was assessed as being credible, although this is highly unlikely given the standard vessel operations and equipment in place to prevent collision at sea, the short duration of installation vessel operations in Operational Area 2 and the construction and placement of storage tanks.

Quantitative Hydrocarbon Risk Assessment

Modelling of a 652 m^3 surface release of marine diesel was available for Woodside's North-west Australia 4D Marine Seismic Survey EP (RPS, 2020). The release location used for the spill modelling is located in the south-west corner of the Operational Area 2, about 200 m from the border of the Ningaloo Coast WHA and 2 km south-west of the IAR location. This scenario was identified as worst case due to its proximity to the coast and metocean conditions modelling shoreline contact.

In addition, the modelled spill volume of 652 m^3 is greater than the worst-case credible release volume of 500 m^3 for this hydrocarbon spill risk assessment. Basing the impact assessment for a vessel collision scenario on this modelling is considered conservative and consequently, the EMBA for a 500 m^3 surface release of marine diesel within Operational Area 2 would be likely be smaller than the EMBA described for this scenario and presented below.

Hydrocarbon Characteristics

Refer to **Section 6.6.2.4** and **Table 6-14**.

Impact Assessment

Potential impacts to environmental values

Environment that May be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling which compiles data from 100 hypothetical worst-case spills under a variety of weather and metocean conditions (as described in **Section 6.6.2.1**). The EMBA, therefore, covers a larger area than the area that would be affected during any one single spill event, and therefore represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs. The trajectory of a single spill would have a considerably smaller footprint.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean transport mechanism, a different EMBA is discussed for each fate.

Surface Hydrocarbons

The surface hydrocarbon spill is predicted to form a surface slick down-current of the release location, with the trajectory dependent on prevailing wind and current conditions at the time. Surface hydrocarbons equal or greater than the 1 g/m^2 and 10 g/m^2 extend up to 94 and 77 km from the release location. Contact of floating hydrocarbons (1 g/m^2) was predicted at the north end of the Ningaloo coast (40%) and the Gascoyne AMP (4.5%).

Entrained Hydrocarbons

In the event of a worst-case scenario occurring, entrained hydrocarbons at or above 500 ppb are forecast to potentially extend up to 302 km from the release site. Contact by entrained hydrocarbons at concentrations equal to or greater than 500 ppb is predicted at Ningaloo Coast with probabilities of 47%. The maximum entrained oil concentration forecast for any receptor is predicted as 102,908 ppb at Ningaloo Coast.

Dissolved Hydrocarbons

The EMBA for dissolved hydrocarbons above the 500 ppb threshold is limited to 55 km kilometres from the spill location. Ningaloo Coast North WHA and Ningaloo Marine Park AMP are predicted to have a low probability (3.5%) of contact by dissolved aromatic hydrocarbon concentrations at the 500 ppb threshold. The maximum dissolved aromatic hydrocarbon concentration forecast for these locations is 1,230 ppb.

Accumulated hydrocarbons

Accumulated shoreline hydrocarbons above the 100 g/m^2 threshold are predicted to contact a portion of Ningaloo coast.

Summary of potential impacts to environmental values(s)

The following sensitive receptors may be impacted by a release of hydrocarbons due to a vessel collision in Operational Area 2:

- protected species
- other habitats, species and communities
- water quality
- protected areas
- socio-economic receptors.

The potential biological, ecological and socio-economic impacts to these receptors from hydrocarbon spills are presented in **Sections 6.6.2.2** and **6.6.2.4**.

In the unlikely event of an unplanned hydrocarbon release to the marine environment due to vessel collision, combined with the adopted controls, it is considered that any potential impact would be minor and short-term in nature to water quality in comparison to background levels and/or international standards with minor and short-term impacts to habitats, populations and shipping/fishing concerns.

The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to vessel collision, as classified in **Figure 2-4**, is defined as D, which equates to 'minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[59]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Marine Order 30 (prevention of collisions) 2016, including: • adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) • adherence to navigation light display requirements, including visibility, light position/shape appropriate to activity • adherence to navigation noise signals as required.	F: Yes CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users and thus the likelihood of a collision.	Controls based on legislative requirements – must be adopted	Yes C 12.1
Marine Order 21 (safety and emergency arrangements) 2016, including: • adherence to minimum safe manning levels • maintenance of navigation equipment in efficient working order (compass/radar) navigational systems and equipment required are those specified in Regulation 19 of Chapter V of Safety of Life at Sea • Automatic Identification System (AIS) that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.	F: Yes CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users and thus the likelihood of a collision.	Controls based on legislative requirements – must be adopted	Yes C 12.2
Good Practice				
500 m operational exclusion zone established around RTM during towing, placement,	F: Yes CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users	Control is good practice.	Yes 2.1b

[59] Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[59]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
stabilisation and augmentation of the RTM as an IAR.		ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.		
Activity support vessel(s) on standby during towing, placement, stabilisation, and augmentation activities to communicate with third-party vessels and assist in maintaining the operational exclusion zone.	F: Yes CS: Minimal cost.	Provides a small reduction in likelihood of a collision with a third party vessel.	Control is good practice.	Yes 2.2b
AHO notified of activity no less than four working weeks before undertaking activities within the Petroleum Activity Program.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHO will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 3.1
DPIRD notified of activities within three months of undertaking activities within the Petroleum Activity Program.	F: Yes CS: Minimal cost. Standard practice.	Communication of the IAR installation activities to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes C 3.2
AMSA notified JRCC of activities 24–48 hours of undertaking activities within the Petroleum Activity Program.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the IAR installation activities to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 3.3
Consultation undertaken with relevant stakeholders for activities within the Petroleum Activities Program that commence more than a year after EP acceptance	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of a	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 3.4

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[59]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
		collision with a third party vessel.		
Mitigation: oil spill response	Refer to **Appendix D**			
Professional Judgement – Eliminate				
	Minimal cost.	No additional controls identified		
Professional Judgement – Substitute				
No additional controls identified				
Professional Judgement – Engineered Solution				
No additional controls identified				
Risk Based Analysis				
A quantitative spill risk assessment was undertaken (see details above)				
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 an unplanned loss of hydrocarbon as a result of vessel collision. 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 an unplanned loss of hydrocarbon as a result of a vessel collision represents a moderate current risk rating that is unlikely to result in potential impact greater than localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines, good oil-field practice/industry best practice, and in some cases are above industry best practice and meet legislative requirements of (Marine Orders 30 and 21). As demonstrated in **Section 6.8**, the residual risk of unplanned hydrocarbon release from vessel collision is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of a loss of vessel structural integrity to a level that is broadly acceptable.				

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 Prevent adverse interactions between vessels/RTM and other marine users during the Petroleum Activities Program.	**C 2.4** Refer to **Section 6.7.1.1**	**PS 2.4** Refer to **Section 6.7.1.1**	**MC 2.4.1** Refer to **Section 6.7.1.1**
	C 2.5 Refer to **Section 6.7.1.1**	**PS 2.5** Refer to **Section 6.7.1.1**	
	C 2.1b Refer to **Section 6.7.1.1**	**PS 2.1b** Refer to **Section 6.7.1.1**	**MC 2.1.1b** Refer to **Section 6.7.1.1**
	C 2.2b Refer to **Section 6.7.1.1**	**PS 2.2b** Refer to **Section 6.7.1.1**	**MC 2.2.1b** Refer to **Section 6.7.1.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 3 Marine users aware of the Petroleum Activities Program.	**C 3.1** Refer to **Section 6.6.1.1**	**PS 3.1** Refer to **Section 6.6.1.1**	**MC 3.2.1** Refer to **Section 6.6.1.1**
	C 3.2 Refer to **Section 6.6.1.1**	**PS 3.2** Refer to **Section 6.6.1.1**	**MC 3.2.1** Refer to **Section 6.6.1.1**
	C 3.3 Refer to **Section 6.6.1.1**	**PS 3.3** Refer to **Section 6.6.1.1**	**MC 3.3.1** Refer to **Section 6.6.1.1**
	C 3.4 Refer to **Section 6.6.1.1**	**PS 3.4** Refer to **Section 6.6.1.1**	**MC 3.4.1** Refer to **Section 6.6.1.1**
EPO 12 No release of hydrocarbons to the marine environment due to a vessel collision associated with the Petroleum Activities Program.	**C 12.1** Refer to **Section 6.6.2.4**	**PS 12.1** Refer to **Section 6.6.2.4**	**MC 12.1.1** Refer to **Section 6.6.2.4**
	C 12.2 Refer to **Section 6.6.2.4**	**PS 12.2** Refer to **Section 6.6.2.4**	
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**.			

6.7.2.3 Unplanned Discharge: Loss of Chemicals / Hydrocarbons from Project Vessels and Grout during Foam and Bend Stiffener Encapsulation

Context	
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Accidental discharge of hydrocarbons/chemicals from project vessels deck activities and equipment (e.g. cranes) and from subsea ROV hydraulic leaks within Operational Area 2.			X			X		A	E	2	M	LCS GP PJ	Broadly acceptable	EPO 14
Accidental discharge of grout during foam and bend stiffener encapsulation		X			X			A	F	2	L			

Description of Source of Risk

Unplanned hydrocarbon and chemical spills

Deck spills can result from spills from stored hydrocarbons/chemicals or equipment. Typical quantities of hydrocarbons/chemicals stored on vessels and types of spills from vessels and ROVs which may occur during the Petroleum Activities Program are outlined in **Section 6.6.2.6** for Operational Area 1 and will be consistent with vessels and activities within Operational Area 2.

The tow, placement, sinking and augmentation of the RTM as an IAR is only expected to take around 15–20 days, with up to three vessels being present in Operational Area 2 during activities. As a result, the period a unplanned discharged could occur is very limited.

Unplanned grout discharges

Grout will be supplied from a hose <200 m long and 4 inches in diameter. A small volume of up to 1.62 m^3 (assuming the entire contents of the hose is lost) could be lost if the hose was to break.

Impact Assessment

Potential impacts to environmental values

Unplanned hydrocarbons and chemical spills

Accidental spills of hydrocarbons or chemicals from project vessels will decrease the water quality in the immediate area of the spill; however, the impacts are expected to be temporary and very localised due to dispersion and dilution in the open ocean environment.

The potential biological and ecological impacts associated with hydrocarbon spills are presented in **Section 6.6.2.2**, further detail on impacts specific to minor deck and subsea spills is provided in **Section 6.6.2.6**. Given the small area of the potential spill and the dilution and weathering of any spill, the likelihood of ecological impacts to marine fauna (including protected species), other communities and habitats will be limited to slight and restricted to individual animals and temporary, localised contamination of water.

Unplanned grout discharges
Grout is not expected to widely disperse and is expected to settle on the seabed in the immediate vicinity of the discharge. The impact at the seabed will therefore, be limited to impacts to sediment quality and any surrounding benthic and/or infauna communities with no lasting effect, in a small localised area immediately around the discharge, similar to that described in **Section 6.7.1.2** for planned excess grout discharges. Given the limited spatial and temporal nature of the discharges, no impacts within the Ningaloo AMP or WHP will occur.
Summary of potential impacts to environmental values(s)
Given the adopted controls, it is considered that minor hydrocarbon/chemical spills or unplanned grout discharges to the marine environment will not result in a potential impact to water quality greater than slight and temporary contamination above background levels, quality standards or known effect concentrations and will not result in a potential impact greater than slight and temporary disruption to a small proportion of biological populations with no impact on critical habitat or activity.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[60]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Marine Order 91 (marine pollution prevention – oil) 2014, requires Ship Oil Pollution Emergency Plan (SOPEP)/Spill Monitoring Programme Execution Plan (SMPEP) (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 13.1
Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/moved temporarily.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Controls based on legislative requirements – must be adopted.	Yes C 14.1
Good Practice				
Spill kits positioned in high risk locations around the vessel (near potential spill points such as transfer stations).	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine environment. The consequence is unchanged.	Benefits outweigh cost/sacrifice.	Yes C 14.2
Primary installation vessels have self-containing hydraulic oil drip tray management system.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine environment. The consequence is unchanged.	Benefits outweigh cost/sacrifice.	Yes C 14.3
Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in **Table 7-6**.				
Professional Judgement – Eliminate				
No bunkering during towing of the RTM or during	F: Yes CS: Minimal cost.	Eliminates the risk and potential impact from a	Benefits outweigh cost/sacrifice.	Yes C 14.4

60 Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[60]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
activities at the proposed IAR location.		diesel spill during bunkering.		
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Below-deck storage of all hydrocarbons and chemicals.	F: Not feasible. During operations there is a need to keep small volumes near activities and within equipment requiring use of hydrocarbons and chemicals and can result in increased risk of leaks from transfers via hose or smaller containers. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
A reduction in the volumes of chemicals and hydrocarbons stored on board the vessel.	F: Yes. Increases the risks associated with transportation and lifting operations. CS: Project delays if required chemicals not on board. Increases the risks associated with transportation and lifting operations.	No reduction in likelihood or consequence since chemicals will still be required to enable activities to occur.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of the potential unplanned accidental deck and subsea spills or grout discharges described above. 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 an unplanned minor discharge of chemicals or hydrocarbons as a result of minor deck and subsea spills and unplanned grout discharges represents a low to moderate risk that is unlikely to result in potential impact greater than slight short-term localised and temporary disruption but not impacting on ecosystem function. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines and good oil-field practice/industry best practice. As demonstrated in **Section 6.8**, the residual risk of unplanned loss of chemicals / hydrocarbons from projects vessels, and from grout during foam and bend stiffener encapsulation, is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential risks.

Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of minor unplanned deck and subsea spills to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 14 No unplanned spills to the marine environment from deck activities greater than a consequence level of E[61] during the Petroleum Activities Program.	**C 13.1** Refer to **Section 6.6.2.5**	**PS 13.1** Refer to **Section 6.6.2.5**	**MC 13.1.1** Refer to **Section 6.6.2.5**
	C 14.1 Refer to **Section 6.6.2.6**	**PS 14.1** Refer to **Section 6.6.2.6**	**MC 14.1.1** Refer to **Section 6.6.2.6**
	C 14.2 Refer to **Section 6.6.2.5**	**PS 14.2** Refer to **Section 6.6.2.6**	**MC 14.2.1** Refer to **Section 6.6.2.6**
	C 14.3 Refer to **Section 6.6.2.6**	**PS 14.3** Refer to **Section 6.6.2.6**	**MC 14.2.1** Refer to **Section 6.6.2.6**
	C 14.4 No bunkering during towing of the RTM or during activities at the proposed IAR location..	**PS 14.4** No bunkering will occur during towing of the RTM or during activities at the proposed IAR location.	**MC 14.4** Records demonstrate no bunkering has occurred during towing of the RTM or during activities at the proposed IAR location.

[61] Defined as ‘Slight, short term local impact (< one year), on species, habitat but not affecting ecosystem function), physical or biological attributes’ as in **Figure 2-6**/**Section 2.6.3**.

6.7.2.4 Unplanned Discharge: Loss of Solid Hazardous / Non-hazardous Wastes within Operational Area 2

Context	
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Accidental loss of hazardous or non-hazardous wastes to the marine environment (excludes sewage, grey water, putrescible waste and bilge water) within Operational Area 2.			X			X		A	F	2	L	LCS GP PJ	Broadly acceptable	EPO 15

Description of Source of Risk

Project vessels will generate a variety of solid wastes including packaging and domestic wastes such as aluminium cans, bottles, paper and cardboard. Hence, there is the potential for solid wastes to be lost overboard to the marine environment. Wastes on-board are managed in accordance with the on-board waste management plan. Some wastes may be incinerated (refer to **Sections 6.6.1.7** and **6.7.1.8**). Based on industry experience, waste items lost overboard are typically wind-blown rubbish such as container lids, cardboard etc. Such losses typically have occurred during back loading activities, periods of adverse weather and incorrect waste storage.

Impact Assessment

Potential impacts to environmental values

The potential impacts of solid wastes accidentally discharged to the marine environment include direct pollution and contamination of the environment and secondary impacts relating to potential contact of marine fauna with wastes, resulting in entanglement or ingestion and leading to injury and death of individual animals. There are a number of migratory and threatened species identified as occurring within Operational Area 2 including cetaceans, marine turtles and whale sharks. However, they are expected to be transient as there are no known key aggregation areas. Operational Area 2 includes some habitat critical to the survival of a species for the green, flatback and loggerhead turtles (as shown in **Table 4-5**) and multiple BIAs. However, the temporary or permanent loss of waste materials into the marine environment is not likely to have a significant environmental impact, based on the types, size and frequency of wastes that could occur the limited time the vessels will be in the Operational Area 2) and transient nature of species present. Given this, impacts will have no lasting effect on any species or water quality.

Summary of potential impacts to environmental values(s)

Given the adopted controls, it is considered that the accidental discharge of solid waste described will result in localised impacts not significant to environmental receptors, with no lasting effect.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[62]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Project 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.	Legislative requirements to be followed reduces the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 15.1
Good Practice				
Installation vessel waste arrangements, which require: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost sacrifice.	Yes C 15.3
Project vessel ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard. Where safe and practicable, this activity will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment or, ROV availability and suitable weather).	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an unplanned release of solid waste and therefore no change to the likelihood. Since the waste objects may be recovered, a reduction in consequence is possible.	Benefit outweighs cost sacrifice.	Yes C 15.4
Professional Judgement – Eliminate				
No additional controls identified.				

[62] Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[62]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of accidental discharges of waste. 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, accidental discharge of solid waste represents a low current risk rating that is unlikely to result in a potential impact above localised, not significant to environmental receptors with no lasting effect. 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 (Marine Orders 94 and 95). Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 15 No unplanned releases of solid hazardous or non hazardous waste to the marine environment greater than a consequence level of F[63] during the Petroleum Activities Program.	**C 15.1** Refer to **Section 6.6.2.7**	**PS 15.1** Refer to **Section 6.6.2.7**	**MC 15.1.1** Refer to **Section 6.6.2.7**
	C 15.3 Refer to **Section 6.6.2.7**	**PS 15.3** Refer to **Section 6.6.2.7**	**MC 15.3.1** Refer to **Section 6.6.2.7**
	C 15.4 Refer to **Section 6.6.2.7**	**PS 15.4** Refer to **Section 6.6.2.7**	**MC 15.4.1** Refer to **Section 6.6.2.7**

[63] Defined as 'No lasting effect (<1 month) or negligible impact. Localised impact not significant to environmental receptors.

6.7.2.5 Physical Presence: Vessel Collision with Marine Fauna within Operational Area 2

Context	
Project Vessels – **Section 3.10**	Biological Environment – **Section 4.4**

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***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Accidental collision between project vessels and threatened and migratory marine fauna within Operational Area 2.						X		A	E	1	L	LCS GP PJ	Broadly acceptable	EPO 16

Description of Source of Risk

The project vessels operating in and around Operational Area 2 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), the RTM during towing and tow lines and marine fauna, potentially resulting in superficial injury, serious injury that may affect life functions (e.g. movement and reproduction) and mortality. The RTM will be towed vertically between 100 m and 500 m behind the vessel when moving from its current location to the proposed IAR location. The factors that contribute to the frequency and severity of impacts due to collisions vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth) and the type of animal potentially present and their behaviours.

Impact Assessment

Potential impacts to environmental values

Vessel disturbance is a key threat to a number of migratory and threatened species identified as occurring within Operational Areas 2 including cetaceans, marine turtles and whale sharks. Relevant conservation actions in these plans are outlined in **Table 4-4**.

As described in **Section 6.6.2.8**, the likelihood of vessel/whale collision being lethal is influenced by vessel speed. Project vessels within Operational Area 2 are likely to be travelling at less than 8 knots (and will often be stationary at the IAR location). The maximum speed during the tow of the RTM will be approximately 2 knots. Therefore, the chance of a vessel collision with protected species resulting in lethal outcome is considered highly unlikely, as fauna have the opportunity to move away from project vessels.

Cetaceans

No known key cetacean aggregation areas (resting, breeding or feeding) are located within or immediately adjacent to Operational Area 2; however, it does overlap the migration BIAs for humpback and pygmy blue whales (**Section 4.4.3.2**). The timing of the activity will be between December and April due to the calmer sea states for safe towing and operations; therefore, it is possible that activity will overlap with the tail end of the pygmy blue whale southbound migration (**Table 4-7**). This could result in increased numbers of pygmy blue transiting Operational Area 2 during migration periods, however, given most individuals have been found to have left the region by early December, this is unlikely.

According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk of a collision with a cetacean 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 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. Given the duration of activities within Operational Area 2 and the slow speeds at which project vessels operate, collisions with cetaceans such as pygmy blue are considered highly unlikely.

Whale sharks

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 Operational Area 2 during their migrations to and from Ningaloo Reef. Aggregations at Ningaloo reef occur between March and November and, therefore, may overlap the timing of activities within Operational Area 2 (December to April). Note that the defined foraging (northward from Ningaloo along 200 m isobath) BIA lies approximately 7 km from Operational Area 2, and the foraging (Ningaloo Marine Park) BIA lies approximately 14 km from Operational Area 2. Operational Area 2 lies between these two BIAs.

Given the duration of activities within Operational Area 2 and the slow speeds at which project vessels operate, the occurrence of collisions with transiting individual whale sharks are considered highly unlikely.

Marine reptiles

The nearest nesting beaches in relation to Operational Area 2 are along the western extent of North West Cape (approximately 16 km from the Operational Area) and the Muiron Islands (24 km from Operational Area 2). North West Cape is a nesting location habitat critical to the survival of green turtles, with nesting occurring November–March (peak: December–February) and hatching during January–May (peak: February–March). South Muiron Island (24 km from Operational Area 2) is a nesting location habitat critical to the survival of loggerhead turtles (nesting November–March, hatching January–May).

With consideration of the absence of potential nesting or foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals) and water depth, it is considered that most of Operational Area 2 is unlikely to represent important habitat for marine turtles, although individuals may infrequently transit the area. It is noted though that the southern portion of Operational Area 2, near the proposed location of the IAR, overlaps:

- Habitat critical to the survival of the species for green, flatback and loggerhead turtles (internesting)
- BIAs for flatback, green, hawksbill and loggerhead turtles (internesting).

Turtles may be particularly vulnerable to vessel strike while surfacing to rest or breathe. However, it has been reported that turtles spend a comparatively limited amount of time (3–6%) at the surface, with dives lasting between 15 and 60 minutes in general (Milton and Lutz, 2003). Turtles have been observed to avoid approaching vessels by moving away from the vessel’s track (Hazel et al., 2007). Hazel et al.,(2007) suggest that this avoidance behaviour is based primarily on visual cues (although the authors acknowledge vessel noise is within range of turtle hearing), and the success of this behaviour in avoiding a vessel strike largely depends on the speed of the approaching vessel and the prevailing water clarity.

Turtles generally aggregate in shallow coastal areas adjacent to nesting beaches or in areas where sufficient food is available; they are unlikely to be present in high numbers within deep waters of Operational Area 2. Therefore, it is expected that the presence of marine turtles will be limited to individual turtles. Given this limited presence, the short duration of the activities and the slows speeds at which the vessels will operate, the occurrence of collisions with marine turtles is considered to be highly unlikely.

Summary

It is highly unlikely, that vessel movement associated with the Petroleum Activities Program in Operational Area 2 will result in collisions with marine fauna. Given, (1) avoidance behaviour commonly displayed by whales, whale sharks and turtles and (2) low operating speed of the activity support vessels (generally less than 8 knots or stationary, unless operating in an emergency) the consequence of any impacts will be limited to slight with no population-level effects.

Summary of potential impacts to environmental values(s)

Given the adopted controls, it is considered that a collision, were it to occur, will not result in a potential impact greater than slight, short term (<1 year) on species, but not affecting on a population level. It is considered to be highly unlikely that a collision will occur.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[64]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[65]: • Project vessels will not travel faster than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow-riding). • If the cetacean or turtle shows signs of being disturbed, project vessels will immediately withdraw from the caution zone at a constant speed of less than six knots. • Vessels will not travel faster than eight knots within 250 m of a whale shark and not allow the vessel to approach closer than 30 m of a whale shark.	F: Yes. CS: Minimal cost. Standard practice.	Implementation of these controls will reduce the likelihood of a collision between a cetacean, whale shark or turtle occurring. The consequence of a collision is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 16.1
Good Practice				
Variation of the timing of the Petroleum Activities Program to avoid key ecological (whale migration, turtle nesting) periods.	F: Not feasible. Timing of activities is linked to PIV availability and the period of most suitable (calm) sea state). Timing of all activities is currently not determined, and due to operational requirements, conducting activities during migration/ nesting seasons may not be able to be avoided.	Not considered – control not feasible.	Not considered – control not feasible.	No

[64] Qualitative measure

[65] For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability; e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[64]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
	CS: Not considered – control not feasible.			
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Use dedicated MFOs on support vessels for the duration of each activity to watch for whales and turtles and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes, however vessel bridge crews already maintain a constant watch during operations, and crew complete specific cetacean observation training. CS: Additional cost of MFOs considered unnecessary.	Given support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not significantly further reduce the risk.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of potential vessel collision with protected marine fauna. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, vessel collision with marine fauna represents a low current risk rating that is unlikely to result in a potential impact to fauna greater than slight, short term with no population-level effects. Habitat critical to the survival of the species within Operational Area 2 include internesting buffers for green, flatback and loggerhead turtles. BIAs within Operational Area 2 include the humpback whale migration BIA, pygmy blue whale migration BIA and internesting BIAs for flatback, green, hawksbill and loggerhead turtles. 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 Act Regulations 2000. As demonstrated in **Section 6.6.2.8**, the residual risk of vessel collision with marine fauna is not inconsistent with the relevant objectives and actions of any applicable recovery plans or threat abatement plans, based on the adopted controls. Regard has been given to relevant conservation advice during the assessment of potential risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of vessel collision with marine fauna to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 16 No vessel strikes with protected marine fauna (whales, whale sharks, turtles) during the Petroleum Activities Program.	**C 16.1** Refer to **Section 6.6.2.8**	**PS 16.1** Refer to **Section 6.6.2.8**	**MC 16.1.1** Refer to **Section 6.6.2.8**
		PS 16.2 Refer to **Section 6.6.2.8**	**MC 16.2.1** Refer to **Section 6.6.2.8**

6.7.2.6 Physical Presence: Disturbance to Seabed from Dropped Objects within Operational Area 2

Context	
RTM Activities – **Section 3.7** Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological Environment – **Section 4.4**

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	Current Risk Rating	ALARP Tools	Acceptability	Outcome
Loss of control of RTM during tow resulting in RTM grounding and causing seabed disturbance at 80 m depth contour					X		X	A	D	0	L	LCS GP PJ	Broadly acceptable	EPO 17
Disturbance to seabed within proposed location of the IAR from dropped objects during placement, stabilisation and augmentation of RTM as an IAR					X			A	F	2	L			
Disturbance to seabed within Operational Area 2 from dropped risers during riser removal					X			A	F	2	L			

Description of Source of Risk

Loss of control of the RTM during tow

During towing of the RTM there is a remote chance that the AHT will lose control of the RTM (e.g. broken tow line). In this situation the RTM would remain afloat in a vertical position given the remaining ballasted and filled compartments, and foam within compartment 13. The second AHT will accompany the towing AHT vessel to support should the towing vessel lose control, and a redundant tow line will be attached to the RTM should the primary tow line or tow point fail. However, should these controls all fail, and control of the RTM could not be regained, it is expected that the RTM would begin floating south where it would ground at the approximately 80 m depth contour in a vertical position. As this stage vessels would regain control of the RTM and recommence towing to the proposed IAR site.

Dropped objects during placement, stabilisation and augmentation of the RTM as an IAR

The RTM and reef modules will be placed on the seabed within a 300 m × 300 m area at the proposed IAR location in a controlled manner, resulting in disturbance to benthic habitats and temporary localised increases in turbidity (**Section 6.7.1.2**). During these activities there is a potential for these objects to be dropped within the planned disturbance area in Operational Area 2.

The 500 m radius defined as the proposed site for the IAR has been established to allow for some flexibility in the exact location of the IAR and, therefore, positioning of the RTM. The RTM would remain within this area should it be lowered more quickly than intended or dropped. The method to lower the RTM (by ballasting compartments) ensures the only likely credible scenario is for the structure to rotate to horizontal after the bottom of the RTM has landed on the seabed.

If a reef module was dropped overboard during placement of these structures, it would sink to the seabed and result in localised disturbance to the seabed within Operational Area 2. The largest modules are 4 m × 4 m × 5 m (high) and could cause disturbance of up to 20 m^2. The modules will be lowered into the water away from RTM until just above

seabed, then manoeuvred into location and placed on seabed, so will not impact on the RTM. If a reef module is dropped it will be retrieved, where possible, and repositioned to achieve the intended design of the IAR. ***Dropped risers during removal from the RTM*** During removal and lifting of the risers, the risers will make contact with the seabed within Operational Area 2. The risers each would result in a maximum approximately 100 m long disturbance to seabed (equivalent to planned disturbance for this activity (**Section 6.7.1.2**). In the event a riser is dropped during recovery the dropped risers would be located and retrieved.
Impact Assessment
Potential impacts to environmental values
Loss of control of the RTM during tow In the remote event that control of the RTM was lost during towing and could not be regained, the structure would float south into the Ningaloo AMP and WHP World Heritage Area where it would ground at the approximately 80 m water depth contour given its vertical orientation. Seabed disturbance would be restricted to the bottom of the RTM temporarily dragging along the seabed at this depth, until it could be safely retrieved. It is not considered credible that the RTM would not be retrieved given the short tow period allows a suitable weather window to be targeted (i.e. loss due to adverse weather conditions is not considered credible). The benthic habitat at this depth is expected to comprise similar habitat as found within the proposed IAR location. Seabed substrates at 70–80 m water depth on the Ningaloo Shelf are dominated by abiotic sediments (sand, pebbles/gravel) with very low percentage cover of sponges, soft corals and other filter feeders (Turner et al., 2018). Deep water, hard coral communities within the Ningaloo AMP and World Heritage Area are limited to water depths shallower than 40 m. As the Ningaloo AMP and World Heritage Area are highly valued and protected under legislation, the consequence of this event occurring is considered to be a minor, short-term impact on habitats, but not affecting ecosystem function. However, should the event occur, no impacts to the values of AMPs are predicted, given the RTM would be recovered and there would be no impacts to sensitive habitats within the AMP and World Heritage Area. ***Dropped objects during placement, stabilisation and augmentation of the RTM as an IAR*** In the unlikely event that the RTM sinks uncontrollably to the seabed the impact to the seabed would remain within the planned area of disturbance, however, there may be a greater plume created resulting in a larger increase in turbidity. However, this would still be contained with Operational Area 2 (i.e. would not extend into the Ningaloo AMP). If a reef module was dropped during augmentation activities, seabed disturbance could occur slightly outside the planned footprint; however, this would be an impact of less than 20 m^2 and would be restricted to within Operational Area 2. The closest hard coral communities to the IAR location (e.g. Helby Banks) are located >11 km distance away. The consequence of either of these events occurring would be localised smothering of benthic habitat and increased turbidity with no lasting effect ***Dropped risers during removal from the RTM*** In the unlikely event that the risers are dropped while they are being pulled from the RTM or lifted to the surface, disturbance to the seabed would be restricted to a consequence of temporary and localised smothering of benthic habitat within Operational Area 2 (approximately 100 m long area) with no lasting effect.
Summary of potential impacts to environmental values(s)
Given the adopted controls and the predicted footprint of credible dropped objects, it is considered that the loss of control of the RTM will not result in a potential impact greater than minor and localised impact on habitats, but not affecting ecosystem function. Impacts from other dropped objects will result in localised and temporary smothering and increased turbidity within Operational Area 2, with no lasting effect. Refer to **Section 6.7.1.2** for discussion of planned seabed disturbance.

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)**[66]	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
No additional controls identified.				

[66] Qualitative measure

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[66]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Good Practice				
Project vessel ROV, crane or support vessel will be used to attempt recovery/repositioning of dropped reef modules, risers or other dropped objects where safe and practicable. This activity will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • ability to recover the object (i.e. nature of object, lifting equipment or, ROV availability and suitable weather).	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an unplanned release and therefore no change to the likelihood. Since the objects may be recovered, a reduction in consequence is possible.	Benefit outweighs cost sacrifice.	Yes C 15.4b
The PIV's work procedures for lifts, bulk transfers and cargo loading, which require: • the security of loads to be checked before commencing lifts • loads to be covered if there is a risk of losing loose materials • lifting operations to be conducted using the PTW and JSA systems to manage the specific risks of that lift, including consideration of weather and sea state.	F: Yes. CS: Minimal cost. Standard practice.	Occurs after a dropped object event and therefore no change to the likelihood. Since the object may be recovered, a reduction in consequence is possible.	Benefits outweigh cost/sacrifice.	Yes C 17.1
PIV inductions include control measures and training for crew in dropped object prevention.	F: Yes. CS: Minimal cost. Standard practice.	By ensuring crew are appropriately trained in dropped object prevention, the likelihood of a dropped object event is reduced. No change in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes C 17.2
Professional Judgement – Eliminate				
Operational Area 2 designed to avoid any impacts to benthic habitat	F: Yes. CS: Minimal cost.	Implementation of Operational Area 2 proximity and alarm buffers reduces the likelihood of seabed	Benefits outweigh cost/sacrifice.	Yes C 5.4

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[66]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
within Ningaloo WHP and AMP, including: • buffer zone adjacent to boundary of Ningaloo WHP and AMP, which comprises a buffer zone commencing at 280 m from boundary to make vessels aware that they are approaching boundary and buffer alarm zone commencing at 100 m from the boundary to alert vessels to not transit further towards Ningaloo WHP and AMP.		disturbance from dropped objects within the Ningaloo AMP and WHP.		
Redundant tow line installed on RTM before towing.	F: Yes. CS: Minimal cost.	Redundant tow line would allow PIV or accompanying PIV AHT to regain control of the RTM in the event the first tow line or tow point fails.	Benefits outweigh cost/sacrifice.	Yes C 17.3
Additional PIV and AHT to accompany towing PIV during tow of RTM to proposed IAR location.	F: Yes. CS: Reduced cost.	Presence of additional vessels will provide contingency support if control of RTM is lost during towing	Benefits outweigh cost/sacrifice.	Yes C 17.4
Do not augment RTM through installation of reef modules	F: Yes. CS: Reduced cost.	Although, it is likely that the RTM structure will provide artificial habitat value (i.e. achieve a purpose) without augmentation, the addition of supporting reef towers is likely to accelerate and further enhance the benefit	Disproportionate reduction in benefits of the IAR in comparison to risk reduction achieved.	No
Professional Judgement – Substitute				
Locate IAR further offshore, away from Ningaloo AMP	F: Yes. CS: Reduced or minimal cost.	Site selection was conducted in alignment with requirements under the Sea Dumping Act to ensure the IAR achieve a purpose. Selected location is in proximity to Ningaloo AMP to facilitate its use by recreational fishers and tourism operators in the region. If IAR was located further offshore this could result in less users being able to	Disproportionate reduction in benefits of the IAR in comparison to risk reduction achieved.	No

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[66]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
		access and, therefore, benefit from the IAR.		
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks from dropped objects. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP				

Demonstration of Acceptability
Acceptability Statement
The impact assessment has determined that, given the adopted controls, dropped objects will not result in a potential impact greater than minor, short-term impact on habitats, but not affecting ecosystem function. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks to benthic environment from dropped objects to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 17 No incidents of dropped objects to the marine environment greater than a consequence level of E[67] during the Petroleum Activities Program.	**C 5.4** Refer to **Section 6.7.1.2**	**PS 5.4** Refer to **Section 6.7.1.2**	**MC 5.4** Refer to **Section 6.7.1.2**
	C 15.4b Project vessel ROV, crane or support vessel will be used to attempt recovery/repositioning of dropped reef modules, risers or other dropped objects where safe and practicable. This activity will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • ability to recover the object (i.e. nature of object, lifting equipment or, ROV availability and suitable weather).	**PS 15.4b** Any hazardous solid waste dropped to the marine environment will be recovered where safe and practicable to do so.	**MC 15.4.1b** Records detail the recovery attempt consideration and status of any hazardous waste lost to marine environment.
	C 17.1 Refer to **Section 6.6.2.9**	**PS 17.1** Refer to **Section 6.6.2.9**	**MC 17.1.1** Refer to **Section 6.6.2.9**

[67] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes'

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 17.2 Refer to **Section 6.6.2.9**	**PS 17.2** Refer to **Section 6.6.2.9**	**MC 17.2.1** Refer to **Section 6.6.2.9**
	C 17.3 Redundant tow line installed on RTM before towing.	**PS 17.3** Redundant tow line will be installed on RTM before towing.	**MC 17.3.1** Records show an additional tow line was installed on the RTM before disconnection.
	C 17.4 Additional PIV and AHT to accompany towing PIV during tow of RTM to proposed IAR location.	**PS 17.4** Additional PIV and AHT will accompany towing PIV during tow of RTM to proposed IAR location.	**MC 17.4.1** Records show additional vessels were present during towing of RTM.

6.7.2.7 Physical Presence: Accidental Introduction of Invasive Marine Species within Operational Area 2

Context		
Project Vessels – **Section 3.10**	Physical Environment – **Section 4.3** Biological 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***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Introduction of invasive marine species within Operational Area 2.					X	X		A	B	0	M	LCS	Broadly acceptable	EPO 18

Description of Source of Risk
NIMS and IMS are defined in **Section 6.6.2.10**. During the Petroleum Activities Program, vessels undertaking activities will be transiting to and from Operational Area 2; potentially including mobilising from beyond Australian waters. These vessels are likely to include two AHTs and one PIV (**Section 3.10**). As described in **Section 6.6.2.10**, all vessels are subject to some level of marine fouling, generally through direct attachment to vessel hulls or by being drawn into ballast tanks. ***Introduction to Operational Area 2*** During the Petroleum Activities Program, project vessels have the potential to introduce IMS to the environment within Operational Area 2 through biofouling (containing IMS) on vessels, as well as ballast water exchange. There is also a remote potential that cross-contamination between vessels may also occur. Although the RTM is currently not considered a credible source of IMS, there is also a remote potential that IMS may be transferred to the RTM during activities within Operational Area 1 to prepare it for disconnection and removal (**Section 6.6.2.10**).

Impact Assessment
Potential impacts to environmental values
Impact pathways and potential consequences of IMS are described in **Section 6.6.2.10**. Despite the potential consequence of the establishment of a marine pest within a high value environment as a result of introduction, unlike coastal or sheltered nearshore waters, the deep offshore open waters (>130 m water depth) of Operational Area 2 are not conducive to the settlement and establishment of IMS. IMS typically require hard substrate in the photic zone to become established. No hard substrate occurs within the photic zone in Operational Area 2 and as such, the introduction and establishment of IMS in this area is not considered credible. However, depending on prevailing currents, the larval life history of the IMS, and the recruitment potential based on a variety of factors, including propagule pressure, there is a remote likelihood that an IMS may be carried to and establish within the shallow waters within the Ningaloo WHP (<50 m depth), where available substrate and light could facilitate establishment and growth. Shallow water marine habitats, such as coral reefs, are considered susceptible to the introduction and subsequent establishment of IMS due to the availability of light and complex habitats. It must however be noted that healthy natural reef ecosystems may also present challenges to IMS establishment relative to degraded shallow water environments due to the increased likelihood of predation and competition. However, IMS introduced to shallow water marine habitats are, therefore, much more likely to successfully establish than those introduced to deep oceanic waters. The Ningaloo Coast WHP is recognised as being of outstanding conservation value, supporting a rich array of habitats and a diverse and abundant marine life (DoEE, n.d.). The proposed IAR will be located a significant distance from any known natural coral reefs within the Ningaloo Coast WHP (and AMP). The Ningaloo Outlook program

(CSIRO-BHP research partnership) has mapped the distribution of deep reefs at Ningaloo. Underwater surveys established that deeper water communities (greater than 50 m) were characterised by the presence of sponges or other non-photosynthetic filter feeders. Corals were confined to depths less than 40 m (Turner et al., 2018). The nearest hard coral communities (e.g. Helby Banks) are located at least 11 km distance away from the IAR site.

Given this sensitivity and the significance of Ningaloo Coast WHP, the consequence of the introduction and successful establishment of an IMS has been determined to represent a consequence level of major (due to the potential for regionally significant impacts to high value habitat). However, the likelihood that an IMS would be introduced, establish a self-sustaining population with Operational Area 2 and cause environmental impacts to sensitive ecological communities within the Ningaloo Coast WHP is considered remote given:

- Project vessels will be subject to Woodside IMS risk assessment process. This process aligns with the approach adopted by WA Department of Primary Industries and Regional Development (e.g. vessel check tool) and has been proven effective in minimising the potential for IMS introduction. Woodside has successfully implemented this process for several large construction projects and ongoing operations over the last decade.
- There remains a significant distance from the Operational Area 2 to the closest shallow water habitat that may be susceptible to the introduction and subsequent establishment of IMS, further reducing the likelihood of the establishment of IMS. Vessels will not enter the Ningaloo WHP during the activity.
- The short duration (15–20 days) of operations further reduces the risk of IMS introduction and subsequent establishment.

Summary of potential impacts to environmental values(s)

The introduction and establishment of IMS in Operational Area 2 is not considered credible due to the lack of hard substrate within the photic zone.

The introduction and establishment of the IMS in the Ningaloo Coast WHA would potentially have major consequences given the sensitivity and the significance of the area. However, given the adopted controls, the distance from the Operational Area (Operational Area 2) to shallow water habitats and the short duration of the activities, the likelihood of the introduction, establishment and impact of an IMS occurring within the Ningaloo Coast WHA is considered remote.

In support of Woodside's assessment of the impacts and risks of IMS introduction associated with the Petroleum Activities Program, Woodside conducted a risk and impact evaluation of the different aspects of a marine pest translocation. The results of this assessment are presented in **Table 6-15**.

As a result of this assessment, Woodside has presented the highest potential consequence of major impacts to the environment, given the sensitivity and significance of the Ningaloo WHP and AMP. However, the likelihood of these impacts occurring is remote, resulting in an overall moderate risk following the implementation of identified controls. For evaluation of risks of IMS within Operational Area 1, refer to **Section 6.6.2.10**.

Table 6-19: Evaluation of risks and impacts from marine pest translocation

IMS Introduction Location	Credibility of Introduction	Consequence of Introduction	Likelihood
Introduced to Operational Area 2 and establishment on the seafloor or subsea structures.	**Not Credible** The deep offshore open waters of Operational Area 2, including at the proposed IAR location, are located away from shorelines (more than 16 km from a shore) and in waters >130 m deep; therefore, they are not conducive to the settlement and establishment of IMS. As described in **Section 6.6.2.10**. There is potential for IMS to be introduced to the RTM during activities conducted within Operational Area 1 to prepare the RTM for disconnection and removal. Currently the RTM is not considered a credible source of IMS (**Section 6.6.2.10**). Given the short duration of activities to prepare the RTM, low risk of vessels introducing IMS to Operational Area 1, and subsequent remote likelihood of this risk, it is not considered credible for IMS to be introduced to the RTM and become established enough to allow them to continue thriving on the structure once it has been placed on the seabed (i.e. beyond the Woodside risk matrix).		
Introduced to Operational Area 2 and establishment on a project vessels or the RTM.	**Credible** There is potential for the transfer of marine pests between project vessels or to the RTM during activities within Operational Area 2.	**Environment – B** The translocation of IMS from a colonised project vessel or the RTM to shallower environments via natural dispersion could result in major impacts to highly valued and sensitive habitats within the Ningaloo WHP and AMP.	**Remote (0)** Interactions between project vessel will be limited during the Petroleum Activities Program, with minimum 500 m operational exclusion zones being adhered to around the RTM, and interactions limited to short periods of time (i.e. during scuttling). There is also no direct contact (i.e. vessels

			are not tied up alongside and RTM will be towed a significant distance behind the PIV) during these activities. Spread of marine pests via ballast water or spawning in these open ocean environments is also considered remote.
Transfer between project vessels and by extension from project vessels to other marine environments beyond Operational Area 2 (i.e. transfer of IMS from offshore primary installation vessel to an activity support vessel and then to another environment).	**Not Credible** This risk is considered so remote that it is not credible for the purposes of the activity. The transfer of a marine pest between project vessels was already considered remote, given the offshore open ocean environment (i.e. transfer pathway discussed above). For a marine pest to then establish into a mature spawning population on the new project vessel (which would have been through Woodside's risk assessment process) and then transfer to another environment is not considered credible (i.e. beyond the Woodside risk matrix). Project vessels are located in an offshore, open ocean, deep environment, where IMS survival is implausible. Furthermore this marine pest once transferred would need to survive on a new vessel with good vessel hygiene (i.e. has been through Woodside's risk assessment process), and survive the transport back from Operational Area 2 to shore. In the event it was to survive this trip, it would then need to establish a viable population in nearshore waters.		

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[68]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
Legislation, Codes and Standards (other than OPGGS Act)				
Project vessels will manage their ballast water using one of the approved ballast water management options, as outlined in the Australian Ballast Water Management Requirements.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of transferring marine pests between project vessels and between project vessels and the RTM within the Operational Area (Operational Area 2). No change in consequence would occur.	Controls based on legislative requirements under the *Biosecurity Act 2015* – must be adopted.	Yes C 18.1
Good Practice				
Woodside's IMS risk assessment process[69] will be applied to the MODU, project vessels and relevant immersible equipment undertaking the	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	Benefits outweigh cost/sacrifice.	Yes C 18.2

[68] Qualitative measure

[69] Woodside's IMS risk assessment process was developed with regard to the National biofouling management guidelines for the petroleum production and exploration industry and Guidelines for the control and management of a ships' biofouling to minimise the transfer of invasive aquatic species (IMO Guidelines, 2011).

Demonstration of ALARP				
Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[68]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Petroleum Activities Program. Assessment will consider the following risk factors: For vessels/MODU: • vessel/MODU type • recent IMS inspection and cleaning history, including for internal niches • out-of-water period before 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 treating internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.		pests between project vessels and between project vessels and the RTM within the Operational Area (Operational Area 2) is reduced. No change in consequence would occur.		

Demonstration of ALARP				
Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[68]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
Professional Judgement – Eliminate				
No discharge of ballast water during the Petroleum Activities Program.	F: No. Ballast water discharges are critical for maintaining vessel stability. Given the nature of the Petroleum Activities Program, using ballast (including the potential discharge of ballast water) is considered to be a safety-critical requirement. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Eliminate use of vessels.	F: No. Given vessels must be used to implement the project, there is no feasible means to eliminate the source of risk. CS: Loss of the project.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
RTM inspected and tested for IMS of concern	F: Yes CS: Reasonable cost.	Given the recent inspection (February 2019) did not identify any evidence of IMS on the RTM, the RTM is not considered a potential source of IMS. It is not considered that further inspection will materially reduce the likelihood of IMS introduction.	Cost/sacrifice outweighs the benefit.	No
Professional Judgement – Substitute				
Source project vessels based in Australia only.	F: Potentially. Limiting activities to only use local project vessels could potentially pose a significant risk in terms of time and duration of sourcing a vessel, as well as the ability of the local vessels to perform the required tasks. For example there are limited PIVs based in Australian	Sourcing vessels from within Australia will reduce the likelihood of IMS from outside Australian waters; however, it does not reduce the likelihood of translocation of species native to Australia but alien to the Operational Area (Operational Area 2) and NWMR, or of IMS that have established elsewhere in Australia. The	Disproportionate. Sourcing vessels from Australian waters may result in a reduction in the likelihood of IMS introduction to the Operational Area (Operational Area 2) or the Ningaloo Coast WHA); however, the potential cost of implementing this control is grossly	No

Demonstration of ALARP				
Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)[68]	Benefit in Impact/Risk Reduction	Proportionality	Control Adopted
	waters. While the project will attempt to source support vessels locally, it is not always possible. Availability cannot always be guaranteed when considering competing oil and gas activities in the region. In addition, sourcing Australian based vessels only will cause increases in cost due to pressures of vessel availability. CS: Significant cost and schedule impacts due to restrictions of vessel hire opportunities.	consequence is unchanged.	disproportionate to the minor environmental gain (or reducing an already remote likelihood of IMS introduction) potentially achieved by using only Australian based vessels. Consequently, this risk is considered not reasonably practicable.	
IMS Inspection of all vessels.	F: Yes. Approach to inspect vessels could be a feasible option. CS: Significant cost and schedule impacts. In addition, the IMS risk assessment process (C 21.2) is seen to be more cost effective, as this control allows Woodside to manage the introduction of marine pests through biofouling, while targeting its efforts and resources to areas of greatest concern.	Inspection of all vessels for IMS would reduce the likelihood of IMS being introduced to the Operational Area (Operational Area 2 or the Ningaloo Coast WHA). However, this reduction is unlikely to be significant given the other control measures implemented. No change in consequence would occur.	Disproportionate. The cost outweighs the benefit gained, as other controls will be implemented to achieve an ALARP position.	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. 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, translocation of IMS may result in a potential major, long-term impact on highly valued ecosystems, species or habitat within the Ningaloo Coast WHP. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of IMS to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 18 No introduction and establishment of invasive marine species into the Operational Areas as a result of the Petroleum Activities Program.	**C 18.1** Refer to **Section 6.6.2.10**	**PS 18.1** Refer to **Section 6.6.2.10**	**MC 18.1.1** Refer to **Section 6.6.2.10**
	C 18.2 Refer to **Section 6.6.2.10**	**PS 18.2** Refer to **Section 6.6.2.10**	**MC 18.2.1** Refer to **Section 6.6.2.10**
			MC 18.2.2 Refer to **Section 6.6.2.10**

6.8 Recovery Plan and Threat Abatement Plan Assessment

As described in **Section 1.10.1.2**, NOPSEMA will not accept an EP that is inconsistent with a recovery plan or threat abatement plan for a listed threatened species or ecological community. 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 Australian Sea Lion (*Neophoca cinerea*) (Commonwealth of Australia, 2013).
- Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) 2014 (Commonwealth of Australia, 2014).
- 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 6-20 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 clearly inconsistent with that action or not. The results of this assessment against relevant actions are presented in **Table 6-21** to **Table 6-26**.

Table 6-20: 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			
B1. Determine trends in index beaches	Y	Y	Y

EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	**Titleholder**	**Petroleum Activities Program**
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 biologically important areas, 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

EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	***Titleholder***	***Petroleum Activities Program***
Australian Sea Lion Recovery Plan			
Overarching Objective			
To halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: • improving the population status leading to the future removal of the Australian sea lion from the threatened species list of the EPBC Act • ensuring that anthropogenic activities do not hinder recovery in the near future or impact on the conservation status of the species in the future	Y	Y	Y
Specific Objectives			
1. Mitigate interactions between fishing sectors (commercial, recreational and Indigenous) and the Australian sea lion to enable the recovery of all breeding colonies	Y		
2. Mitigate the impacts of marine debris on Australian sea lion populations	Y	Y	
3. Mitigate the impacts of aquaculture operations on Australian sea lion populations	Y		
4. Investigate and mitigate other potential threats to Australian sea lion populations, including disease, vessel strike, pollution and tourism	Y	Y	Y
5. Continue to develop and implement research and monitoring programs that provide outputs of direct relevance to the conservation of the Australian sea lion	Y	Y	
6. Increase community involvement in, and awareness of, the recovery program	Y		
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		

EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	*Titleholder*	*Petroleum Activities Program*
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			
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

EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	***Titleholder***	***Petroleum Activities Program***
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		
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 6-21: 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 6.7.2.1** **Not inconsistent assessment**: The assessment of accidental release of plastics from the RTM has considered the potential risks to green, loggerhead and flatback turtles. There is no cause-effect pathway for turtle ingestion of macro- and microplastics originating from the RTM, and no turtle foraging occurs at the RTM location or in adjacent waters.	**EPO 19 and 20** **C 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5** **PS 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5**
	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 6.6.2.2**, **6.6.2.3**, **6.6.2.4**, **6.6.2.5**, **6.6.2.6**, **6.7.2.2**, and **6.7.2.3** **Not inconsistent assessment**: The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to green, loggerhead and flatback turtles. Spill risk strategies and response program include management measures for turtles and their nesting habitats.	Refer **Section 7.9** Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**
	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	Refer **Sections 6.6.1.5** and **6.7.1.6** **Not inconsistent assessment**: The assessment of light emissions has considered the potential impacts to green, loggerhead and flatback turtles. Internesting, mating, foraging or migrating turtles are not impacted by light from offshore vessels. Vessel light emissions could cause localised and temporary behavioural disturbance to isolated transient individuals, which is unlikely to result in	N/A

Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
		important behaviours of nesting adults and emerging/dispersing hatchlings can continue	displacement of adult turtles from internesting or nesting habitat critical to the survival of marine turtles.	
	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[70].	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 North West Shelf stock to other stocks • LH-WA – no relevant actions • F-Pil – no relevant actions	Refer **Sections 6.6.1.6** and **6.7.1.7** **Not inconsistent assessment**: The assessment of acoustic emissions has considered the potential impacts to green, loggerhead and flatback turtles. Vessel and transponder acoustic emissions could cause localised and short-term behavioural disturbance to isolated transient individuals, which is unlikely to result in displacement of adult turtles from internesting or nesting habitat critical to the survival of marine turtles.	N/A

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.

[70] http://www.ningalooturtles.org.au/media_reports.html

Table 6-22: 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 biologically important areas will be managed such that any blue whale continues to use the area without injury, and is not displaced from a foraging area	Refer **Sections 6.6.1.6** and **6.7.1.7** **Not inconsistent assessment**: The assessment of acoustic emissions has considered the potential impacts to pygmy blue whales. Acoustic emissions from project vessels and MODU will not cause injury to any blue whale. If the Petroleum Activities Program overlaps with the southbound migration, individuals may deviate slightly from the migratory route, but will continue on their migration and will not be displaced from the possible foraging area at Ningaloo.	N/A
	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 **Sections 6.6.2.8** and **6.7.2.5** **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 overlaps with the southbound migration, individuals may deviate slightly from migratory route, but will continue on their migration. Vessel collisions with pygmy blue whales are highly unlikely to occur, given the very slow vessel speeds.	**EPO 16** **C 16.1** **PS 16.1 and 16.2**
	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 Biologically Important Areas	**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[71]).	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.				

[71] 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

Table 6-23: Assessment against relevant actions of the Australian Sea Lion Recovery Plan

Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
Australian Sea Lion Recovery Plan	**Objective 4**: Investigate and mitigate other potential threats to Australian sea lion populations, including disease, vessel strike, pollution and tourism	**Action 4.1**: Improve the understanding of—and where necessary mitigate—the threat posed to Australian sea lion populations by illegal killings, vessel strike, pollution and oil spills	Refer **Sections 6.6.2.2**, **6.6.2.3**, **6.6.2.4**, **6.6.2.5**, **6.6.2.6**, **6.7.2.2**, and **6.7.2.3** **Not inconsistent assessment**: The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to Australian sea lions.	Refer **Section 7.9** Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**
Assessment Summary The Australian Sea Lion 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.				

Table 6-24: 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 6.7.2.1** **Not inconsistent assessment**: The assessment of accidental release of plastics from the RTM has considered the potential risks to grey nurse sharks. There is no cause-effect pathway for grey nurse shark ingestion of macro- and microplastics originating from the RTM.	**EPO 19 and 20** **C 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5** **PS 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5**
			Refer **Sections 6.6.2.2**, **6.6.2.3**, **6.6.2.4**, **6.6.2.5**, **6.6.2.6**, **6.7.2.2**, and **6.7.2.3** **Not inconsistent assessment**: The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to grey nurse sharks.	Refer **Section 7.9** Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**
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.				

Table 6-25: 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 6.6.2.2**, **6.6.2.3**, **6.6.2.4**, **6.6.2.5**, **6.6.2.6**, **6.7.2.2**, and **6.7.2.3** **Not inconsistent assessment**: The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to sawfish and river shark.	Refer **Section 7.9** Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are present in **Appendix D**
	Objective 6: Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species	**Action 6a**: Assess the impacts of marine debris including ghost nets, fishing gear and plastics on sawfish and river shark species	Refer **Section 6.7.2.1** **Not inconsistent assessment**: The assessment of accidental release of plastics from the RTM has considered the potential risks to sawfish and river shark. There is no cause-effect pathway for sawfish and river shark ingestion of macro- and microplastics originating from the RTM.	**EPO 19 and 20** **C 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5** **PS 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5**
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.				

Table 6-26: 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 6.7.2.1** **Not inconsistent assessment**: The assessment of accidental release of plastics from the RTM has considered the potential risks to vertebrate wildlife (Part 3 protected species). There is no cause-effect pathway for vertebrate wildlife ingestion of macro- and microplastics originating from the RTM.	**EPO 19 and 20** **C 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5** **PS 19.1, 19.2, 20.1, 20.2, 20.3, 20.4 and 20.5**
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.				

7 IMPLEMENTATION STRATEGY

7.1 Overview

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 environmental performance outcomes and standards outlined in this EP are achieved.

Woodside, as Operator, is responsible for ensuring that the Petroleum Activities Program is managed in accordance with this Implementation Strategy and the WMS (see **Section 1.9**).

7.2 Systems, Practice, and Procedures

All operational activities are planned and carried out in accordance with relevant legislation and standards, management measures (i.e. controls) identified in this EP and internal environment standards and procedures (**Section 7**).

The systems, practices and procedures that will be implemented are listed in the Performance Standards (PS) contained in this EP. Document names and references numbers may change during the statutory duration of this EP and are managed through a changes register and update process.

7.3 Roles and Responsibilities

Key roles and responsibilities for Woodside and contractor personnel relating to implementing, managing and reviewing this EP are described in **Table 7-1**. An additional key role and responsibilities for the long-term (30-year) monitoring and management of the IAR by Recfishwest as required by the artificial reef permit are also outlined here for completeness. Roles and responsibilities for oil spill preparation and response are outlined in **Appendix D**.

Table 7-1: Roles and responsibilities

Title (role)	Environmental Responsibilities
Office-based Personnel	
NGA Asset Manager	• Ensures compliance with Woodside's HSE Policy, all relevant environmental legislative requirements and environmental operational controls as detailed in this EP. • Reports environmental incidents to the Developments Environment Manager and ensures follow up actions are carried out. • Liaises with regulatory authorities as required. • Ensures resources are available to deliver this EP. • Ensures review of daily, weekly and monthly reporting from the PIV and support vessels. • Consults with the Developments Environment Manager to develop corrective actions addressing any environmental issues in relation to the Petroleum Activities Program. • Ensures the importance of appropriate levels of training, competency and environmental awareness are communicated amongst the PIV and support vessel personnel. • Ensures action items from environmental audits are completed. • Ensures the importance of appropriate levels of training, competency and environmental awareness are communicated amongst the PIV and support vessel personnel. • Ensures action items from environmental audits are completed.
Woodside Developments Environment Manager	• Overall coordination of environmental management across the Developments Division to ensure the performance outcomes, standards and measurement criteria of the offshore EPs are met. • Verifying Developments Division understands and adheres to legislative and regulatory requirements, EPs and the WMS. • Guiding and driving the direction of environmental management across the Developments Division, maintaining alignment with the Corporate Environment functional direction. • Facilitating environmental approval documentation for the Developments Division and its timely submission in accordance with regulatory requirements and Woodside standards. • Providing governance on environmental standards and EP compliance. • Monitoring and communicating to internal stakeholders any relevant changes to legislation, policies, regulator organisation that may impact the EP or business. • Developing and maintaining appropriate environmental processes for Developments and contractors. • Developing environmental improvement plans, targets and key performance indicators (KPIs) with divisional management. • Supporting the divisional environmental performance through implementation of effective environmental training programs. • Monitoring and review progress against environmental improvement plans, targets and KPIs with divisional management to drive continuous improvement.

Title (role)	Environmental Responsibilities
Woodside Developments Environment Adviser	• Verifying Developments Division understands legislative and regulatory requirements, EPs and the WMS. • Developing, review and control revisions of the EP and maintaining in accordance with EP commitments. • Assisting in implementing and facilitating environmental improvement plans. • Ensuring appropriate personnel have access to the EP and understand the outcomes, standards and measurement criteria and their environmental responsibilities for the activity. • Liaising with applicable regulatory authorities and stakeholders as required. • Developing and maintaining environmental training inductions, awareness refreshers and environment toolbox topics for deployment to offshore personnel. • Coordinating environmental monitoring and reporting requirements from the EP including environmental performance and compliance reporting; • Monitoring progress against environmental improvement plans. • Participating in environmental audits/inspections to ensure regular checking of compliance with the EP. Communicating findings to management and assisting with closeout of audit actions. • Assisting with review, investigation and reporting of environmental incidents. • Preparation and delivery/dissemination of environmental training material.
Woodside Corporate Affairs Adviser	• Prepare and implement the Stakeholder Consultation Plan for Petroleum Activities Program. • Report on stakeholder consultation. • Ongoing liaison as required.
Project Managers / Engineers	• Changes to the decommissioning program are communicated to the Decommissioning Environmental Adviser. • All decommissioning chemical components and other fluids that are be used have been reviewed by the Project Environmental Adviser.
Woodside Marine Assurance Superintendent	• Conducts relevant audit and inspection to confirm vessels are in compliance with relevant Marine Orders and Woodside Marine Charters Instructions requirements to meet safety, navigation and emergency response requirements.
Woodside Corporate Incident Coordination Centre (CICC) Duty Manager	On receiving notification of an incident, the Woodside CICC Duty Manager shall: • establish and take control of the Incident Management Team (IMT) and establish an appropriate command structure for the incident • assess situation, identify risks and actions to minimise the risk • communicate impact, risk and progress to the Crisis Management Team and stakeholders • develop the incident action plan (IAP) including setting objectives for action • approve, implement and manage the IAP • communicate within and beyond the incident management structure • manage and review safety of responders

Title (role)	Environmental Responsibilities
	• address the broader public safety considerations • conclude and review activities.
Vessel-based Personnel	
Vessel Master	• The vessel management system and procedures are implemented. • Personnel commencing work on the vessel receive an environmental induction that meets the relevant requirements specified in this EP. • Personnel are competent to undertake the work they have been assigned. • SOPEP drills are conducted as per the vessel's schedule. • The vessel Emergency Response Team has been given sufficient training to implement the SOPEP. • Any environmental incidents or breaches of relevant environmental performance outcomes or performance standards detailed in this EP, are reported immediately to the Woodside Representative. Corrective actions for incidents or breaches are developed, communicated to the Woodside Representative, and tracked to close out in a timely manner. Close out of actions is communicated to the Woodside Representative.
Vessel HSE Advisers	• Verify that the environmental performance outcomes and performance standards are undertaken as detailed in this EP. • Support the Project Manager and the NGA Asset Manager to ensure the environmental performance outcomes are met and the performance standards detailed in this EP are implemented on the project vessels. • Verify environmental incidents or breaches of outcomes, standards or criteria outlines in this EP, are reported as per the Woodside Corporate Event Notification Matrix. • Confirm periodic environmental inspections are completed. • Review Contractors procedures, Input into Toolbox talks and JSAs. • Provide day-to-day environmental support for activities in consultation with the Project Environmental Adviser.
Vessel Logistics Coordinators	• Waste is managed on the relevant activity support vessels and sent to shore as per the relevant Waste Management Plan.
MODU-based Personnel	
MODU Offshore Installation Manager	• Ensure the MODU's management system and procedures are implemented. • Ensure the personnel starting work on the MODU receive an environmental induction that meets the requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure emergency drills are conducted as per the MODU's schedule. • Ensure the MODU's Emergency Response Team has been given sufficient training to implement the MODU's SOPEP
Recfishwest	
Recfishwest Chief Executive Officer	• Ensure the IAR has been successfully deployed in accordance with the requirements of the artificial reef permit. • Ensure ongoing implementation of the Long-term Management Plan in accordance with the artificial reef permit.

It is the responsibility of all Woodside employees and contractors to implement the Woodside Corporate Health, Safety, Environment and Quality Policy (**Appendix A**) in their areas of responsibility and that the personnel are suitably trained and competent in their respective roles.

7.4 Training and Competency

7.4.1 Overview

Woodside as part of its contracting process undertakes assessments of a proposed contractor's environmental management systems to determine the level of compliance with the standard AS NZ ISO 14001. This assessment is undertaken for the Petroleum Activities Program as part of the pre-mobilisation process. The assessment determines whether there is a clearly defined organisational structure that clearly defines the roles and responsibilities for key positions. The assessment also assesses whether there is an up-to-date training matrix that defines any corporate and site/activity-specific environmental training and competency requirements.

As a minimum, environmental awareness training is required for all personnel, detailing awareness and compliance with the contractor's environmental policy and environmental management system.

7.4.2 Inductions

Inductions are provided to all relevant personnel before the mobilisation to or on arrival at the activity location. The induction covers the HSE requirements and environmental information specific to the activity location. A record of attendance will be maintained.

The Petroleum Activities Program induction may cover the following information:

- ecological and socio-economic values of the activity location
- description of the activity
- regulations relevant to the activity
- woodside Environmental Management System – Health Safety, Environment and Quality Policy
- EP importance/structure/implementation/roles and responsibilities
- main environmental aspects/hazards and potential environmental impacts and related performance outcomes
- oil spill preparedness and response
- monitoring and reporting on performance outcomes and standards using measurement criteria
- incident reporting.

7.4.3 Petroleum Activity-specific Environmental Awareness

Prior to commencing each component of the Petroleum Activities Program, a Woodside representative will hold a pre-activity meeting on-board project vessels with all relevant personnel. The pre-activity meeting provides an opportunity to reiterate specific environmental sensitivities or commitments associated with the activity. Attendance lists are recorded and retained. Relevant sections of the pre-activity meeting will also be communicated through to the support vessel personnel.

During operations, regular HSE meetings will be held on project vessels which cover all crew. During these meetings, recent environmental incidents are reviewed and awareness material presented on a regular basis. Attendance is recorded and lists retained on the project vessels.

7.4.4 Management of Training Requirements

All personnel on the project vessels are required to be competent to perform their assigned positions. This may be in the form of external or 'on the job' training. The vessel Safety Training Coordinator (or equivalent) is responsible for identifying training needs, keeping records of training undertaken and identifying minimum training requirements. Spill response training is mandatory for relevant teams. Environmental awareness is also included in inductions.

7.5 Monitoring, Auditing, Management of Non-Conformance and Review

7.5.1 Monitoring

Woodside and its Contractors will undertake a program of periodic monitoring during the Petroleum Activities Program – starting at mobilisation of each activity and continuing through the duration of each activity to activity completion. This information will be collected using the tools and systems outlined below, developed based on the environmental performance outcomes, controls, standards and measurement criteria in this EP. The tools and systems will collect, as a minimum, the data (evidence) referred to in the measurement criteria in **Section 6** and **Appendix D**.

The collection of this data (against the measurement criteria) will form part of the permanent record of compliance maintained by Woodside and will form the basis for demonstrating that the environmental performance outcomes and standards are met, which will be summarised in a series of routine reporting documents.

7.5.1.1 Source-Based Impacts and Risks

The tools and systems to monitor environmental performance, where relevant, will include:

- daily reports undertaken during well intervention activities and inspections, which include leading indicator compliance
- quarterly review of waste management and recycling records
- use of MODU / intervention vessel, PIV and activity support vessel contractor's risk identification program that requires personnel to record and submit safety and environment risk observation cards on a routine basis
- collection of evidence of compliance with the controls detailed in the EP relevant to offshore activities by the Woodside Offshore HSE Adviser (or equivalent) (other compliance evidence is collected onshore)
- environmental discharge reports that record volumes of planned and unplanned discharges downhole (in the well), to ocean and atmosphere
- monitoring of progress against the Developments function scorecard for KPIs
- internal auditing and assurance program as described in Section 7.5.2.

Throughout this activity, Woodside will continuously identify new source-based risks and impacts through the Monitoring and Auditing systems and tools described above and in **Section 7.5.2**.

7.5.1.2 Receptor-Based Knowledge Updates

Under the Woodside Environmental Knowledge Management System, regular monitoring to maintain currency of receptor knowledge is performed as follows:

- DoEE EPBC Act listed species status, listed species Recovery/Management and Conservation Plans, and other environmental matters is reviewed quarterly and recorded by Environment Science team. The outcome of each review is summarised and issued to the relevant Environment personnel responsible for implementing the EP for their consideration.

- Under the Oil Spill Scientific Monitoring Programme preparedness, an annual review and update to the environmental baseline studies database is completed and documented.
- Periodic location-focused environmental studies 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.

7.5.2 Auditing and Inspections

Environmental performance auditing will be undertaken to:

- identify potential new, or changes to existing environmental impacts and risk, and methods for reducing those to ALARP;
- confirm that mitigation measures detailed in this EP are effectively reducing environmental impacts and risk, that mitigation measures proposed are practicable and provide appropriate information to verify compliance; and
- confirm compliance with the Performance Outcomes, Controls and Standards detailed in this EP.

Proposed audits include:

- Start up or pre-mobilisation audits; and
- Offshore environmental inspections.

Non-conformances identified will be reported and/or tracked in accordance with **Section 7.5.3**. Audit findings relevant to continuous improvement of environmental performance are tracked through a compliance action register.

7.5.2.1 Start-Up/Pre-Mobilisation Audit

An audit will be undertaken to align with each key project campaign. Start-up or pre-mobilisation audits will be undertaken before the following commence:

- RTM removal (Section 3.6)
- Well intervention campaign (Section 3.9).

The scope of these audits will focus on ensuring all personnel are aware of environmental commitments and appropriate environmental controls are in place.

7.5.2.2 Environmental Inspections

Environmental inspections will also be undertaken fortnightly for each campaign by offshore personnel. Selected risk areas will be inspected during routine visits throughout the campaign, determined by risk, previous incidents and operation specification requirements.

7.5.3 Management of Non-Conformance

Woodside classifies non-conformances with environmental performance outcomes and standards in this EP as environmental incidents. Woodside employees and contractors are required to report all environmental incidents, and these are managed as per Woodside's internal event recording, investigation and learning requirements.

An internal computerised database called First Priority is used to record and report these incidents. Details of the event, immediate action taken to control the situation, investigation outcomes and corrective actions to prevent recurrence are all recorded. Corrective actions are monitored using First Priority and closed out in a timely manner.

Woodside uses a consequence matrix for classification of environmental incidents, with the significant categories being A, B and C (as detailed in **Section 2.6**). Detailed investigations are completed for all categories A, B, C and high potential environmental incidents.

7.5.4 Long-term Monitoring of the IAR

Once installation of the IAR is complete, ownership of the reef will transfer to the State Government (DPIRD) (**Section 1.10.1.3**). Recfishwest, as the permit applicant, is responsible for monitoring the reef over the 30-year monitoring period.

As part of the artificial reef permit application, Recfishwest have created a long-term monitoring plan for the IAR. This plan details the monitoring requirements for the artificial reef for 30 or more years post-deployment. The frequency of monitoring varies throughout this LTMP. The first five years post-deployment are designated as an intensive monitoring period, with annual inspections for structural integrity and stability, environmental changes and progression, and social usage, and perception of the artificial reef. This also includes a visual inspection immediately following the installation of the artificial reef to validate the location and orientation of each of the reef modules, and ensure that the installation is successful. Following this intensive 5-year period, monitoring will be conducted every 5 years, up until 30 years post-deployment. The proposed duration and frequency of monitoring is subject to assessment upon submission of the permit application.

The requirements for monitoring beyond 30 years will be determined by an assessment at the end of the 30-year monitoring period. The results of monitoring conducted over the 30-year period will be reported to the Commonwealth Department for the Environment (at the time), which will assess whether the artificial reef may remain in place, or if decommissioning options are required.

Monitoring will be for:

- stability (**Section 6.7.1.2**)
- IMS (**Section 6.7.2.7**)
- contaminants (**Section 6.7.1.3**)
- foam release (**Section 6.7.2.1**)
- plastic containment (**Section 6.7.2.1**)
- hydraulic fluid release (**Section 6.7.1.5**)
- aluminium and zinc anode depletion (**Section 6.7.1.3**)
- iron ore release (**Section 6.7.1.3**)
- environmental impacts (**Section 6.7**).

In the event that changes relating to any of the above items are identified, these will be reported to the relevant government department by Recfishwest. Subsequently, assessment of the identified changes will determine the management and response required to reduce the risk posed to accepatable and ALARP.

7.5.5 Review

7.5.5.1 Management Review

Within the Environment Function, senior management regularly monitor and review environmental performance and the effectiveness of managing environmental risks and performance. Within in each Function and Business Unit Leadership Team Managers review environmental performance on a regular basis.

7.5.5.2 Learning and Knowledge Sharing

Learning and knowledge sharing occurs via a number of different methods including:

- event investigations
- event bulletins
- after action review conducted at the end of each well, including review of environmental incidents as relevant
- ongoing communication with MODU / intervention vessel, PIV and activity support vessel operators
- formal and informal industry benchmarking
- cross asset learnings
- engineering and technical authorities discipline communications and sharing.

7.5.5.3 Review of Impacts, Risks, and Controls Across the Life of the EP

In the unlikely case that activities described in this EP do not occur continuously or sequentially, before recommencing activities after a cessation period greater than 12 months, impacts, risks and controls will be reviewed.

The process will identify or review impacts and risks associated with the newly-commencing activity, and will identify or review controls to ensure impacts and risks remain/are reduced to ALARP and acceptable levels. Information learned from previous activities conducted under this EP will be considered. Controls which have previously been excluded on the basis of proportionality will be reconsidered. Any required changes will be managed by the MoC process outlined below (**Section 7.6**).

7.6 Environment Plan Management of Change and Revision

Management of changes relevant to this EP, concerning the scope of the activity description (**Section 3**) including: review of advances in technology at stages where new equipment may be selected such as vessel contracting, changes in understanding of the environment, including all current advice from DoEE on species protected under EPBC Act and current requirements for Australian Marine Parks (**Section 4**); and potential new advice from external stakeholders (**Section 4)** will be managed in accordance with Regulation 17 of the Environment Regulations.

Risk will be assessed in accordance with the environmental risk management methodology (**Section 2.5**) to determine the significance of any potential new environmental impacts or risks not provided for in this EP. Risk assessment outcomes are reviewed in compliance with Regulation 17 of the Environment Regulations.

Minor changes where a review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a revision, under Regulation 17 of the Environment Regulations, will be considered a ‘minor revision’. Minor administrative changes to this EP, where an assessment of the environmental risks and impacts is not required (e.g. document references, phone numbers, etc.), will also be considered a ‘minor revision’. Minor revisions as defined above will be made to this EP using Woodside’s document control process. Minor revisions will be tracked in an MoC Register to ensure visibility of cumulative risk changes, as well as enable internal EP updates/reissuing as required. This document will be made available to NOPSEMA during regulator environment inspections.

7.7 Record Keeping

Compliance records (outlined in Measurement Criteria in **Section 6**) will be maintained.

Record keeping will be in accordance with Regulation 14(7) that addresses maintaining records of emissions and discharges.

7.8 Reporting

To meet the environmental performance outcomes and standards outlined in this EP, Woodside undertake reporting at a number of levels, as outlined in the next sections.

7.8.1 Routine Reporting (Internal)

7.8.1.1 Daily Progress Reports and Meetings

Daily reports for activities are prepared and issued to key support personnel and stakeholders, by relevant managers responsible for the activity. The report provides performance information on the activities, heath, safety and environment, and current and planned work activities.

Meetings between key personnel are used to transfer information, discuss incidents, agree plans for future activities and develop plans and accountabilities for issue resolution.

7.8.1.2 Regular HSE Meetings

Regular dedicated HSE meetings are held with the offshore and Perth-based management and advisers to address targeted HSE incidents and initiatives. Minutes of these meetings are produced and distributed as appropriate.

7.8.1.3 Performance Reporting

Monthly and quarterly performance reports are developed and reviewed by the Function and Business Unit Leadership Teams. These reports cover a number of subject matters, including:

- HSE incidents (including high potential incidents and those related to this EP) and recent activities
- corporate Key Performance Indicator targets, which include environmental metrics
- outstanding actions as a result of audits or incident investigations
- technical high and low lights.

7.8.2 Routine Reporting (External)

7.8.2.1 Start and End Notifications of the Petroleum Activities Program

In accordance with Regulation 29, Woodside will notify NOPSEMA and DMIRS of the commencement of the Petroleum Activities Program at least ten days before the activity commences, and will notify NOPSEMA and DMIRS within ten days of completing the activity. For activities covered under the EP for Operational Area 2, including removing the RTM from its current location, towing it to the proposed IAR location and installing the IAR, Woodside will notify NOPSEMA at least 10 days prior to the activities commencing and within 10 days following completion of the IAR installation and once liability has been transferred to DPIRD (**Section 1.10.1.3**).

7.8.2.2 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. Regulatory reporting requirements are summarised in **Table 7-2**.

Table 7-2: Routine external reporting requirements

Report	Recipient	Frequency	Content
Monthly Recordable Incident Reports	NOPSEMA	Monthly, by the 15th of each month.	Details of recordable incidents that have occurred during the Petroleum Activities Program for previous month (if applicable).
Environmental Performance Report	NOPSEMA	Annually, with the first report submitted within 12 months of the commencement of the Petroleum Activity Program covered by this EP (as per the requirements of Regulation 14(2).	Compliance with environmental performance outcomes, controls and standards outlined in this EP, in accordance with the Environment Regulations.

7.8.2.3 End of the Environment Plan

The EP will end when Woodside notify NOPSEMA that the Petroleum Activities Program has ended and all the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A of the Environment Regulations.

7.8.3 Incident Reporting (Internal)

The process for reporting environmental incidents is described in **Sections 7.8.3** and **7.8.4** of this EP. It is the responsibility of the Woodside Project Manager to ensure that reporting of environmental incidents meets Woodside's and regulatory reporting requirements as detailed in the Woodside Health, Safety and Environment Event Reporting and Investigation Procedure and this section of this EP.

7.8.4 Incident Reporting (External) – Reportable and Recordable

7.8.4.1 Reportable Incidents

Definition

A reportable incident as 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 C+ (as defined under Woodside's Risk Table [refer to **Table 2-3**])
- an incident that has the potential to cause environmental damage with a Consequence Level C+ (as defined under Woodside's Risk Table [refer to **Table 2-3**]).

The environmental risk assessment (**Section 6**) for the Petroleum Activities Program identifies those risks with a potential consequence level of C+ for environment. The incidents that have the potential to cause this level of impact include hydrocarbon loss of containment events to the marine environment resulting from a loss of well integrity.

Any such incidents represent potential events which would be reportable incidents. Incident reporting is undertaken with consideration of NOPSEMA (2014) guidance stating, 'if in doubt, notify NOPSEMA', and assessed on a case-by-case basis to determine if they trigger a reportable incident as defined in this EP and by the Regulations.

Notification

NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations. Woodside will:

- report all reportable incidents to the regulator (orally) as soon as practicable, but within two hours of the incident or of its detection by Woodside
- provide a written record of the reported incident to NOPSEMA, the National Offshore Petroleum Titles Administrator (NOPTA) and the Department of the responsible State Minister (DMIRS) as soon as practicable after the oral reporting of the incident
- complete a written report for all reportable incidents using a format consistent with the NOPSEMA Form FM0929 – Reportable Environment Incident (**Appendix E**) which must be submitted to NOPSEMA as soon as practicable, but within three days of the incident or of its detection by Woodside
- provide a copy of the written report to NOPTA and DMIRS, within seven days of the written report being provided to NOPSEMA.

AMSA will be notified of oil spill incidents as soon as practicable following the occurrence, and DoEE notified if MNES are to be affected by the oil spill incident.

7.8.4.2 Recordable Incidents

Definition

A recordable incident as defined under Regulation 4 of the Environment Regulations as an incident arising from the activity that 'breaches an environmental performance outcome or environmental performance standard, in the EP that applies to the activity, that is not a reportable incident'.

Notification

NOPSEMA will be notified of all recordable incidents, according to the requirements of Regulation 26B(4), not later than 15 days after the end of the calendar month using the NOPSEMA Form – Recordable Environmental Incident Monthly Summary Report (**Appendix E**) detailing:

- all recordable incidents that occurred during the calendar month
- all material facts and circumstances concerning the recordable incidents that the operator knows or is able, by reasonable search or enquiry, to find out
- any action taken to avoid or mitigate any adverse environment impacts of the recordable incidents
- the corrective action that has been taken, or is proposed to be taken, to prevent similar recordable incidents
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

7.8.4.3 Other External Incident Reporting Requirements

In addition to the notification and reporting of environmental incidents defined under the Environment Regulations and Woodside requirements, **Table 7-3** describes the incident reporting requirements that also apply in the Operational Area.

Table 7-3: External incident reporting requirements

Event	Responsibility	Notifiable party	Notification requirements	Contact	Contact detail
Any marine incidents during Petroleum Activities Program	Vessel Master	AMSA	Incident Alert Form 18 as soon as reasonably practicable* Within 72 hours after becoming aware of the incident, submit Incident Report Form 19	AMSA	reports@amsa.gov.au
Oil pollution incidents in Commonwealth waters	Vessel Master	AMSA JRCC	As per Article 8 and Protocol I of MARPOL within two hours via the national emergency 24-hour notification contacts and a written report within 24 hours of the request by AMSA	AMSA Rescue Coordination Centre (RCC) Australia	If the ship is at sea, reports are to be made to: Free call: 1800 641 792 Phone: 08 9430 2100 (Fremantle)
Oil pollution incidents in Commonwealth waters	Vessel Master	AMSA JRCC	Without delay as per Protection of the Sea Act, part II, section 11(1), AMSA RCC notified verbally via the national emergency 24-hour notification contact of the hydrocarbon spill; follow up with a written Pollution Report as soon as practicable after verbal notification	AMSA RCC Australia	Phone: 1800 641 792 or +61 2 6230 6811 AFTN: YSARYCYX
Any oil pollution incident which has the potential to enter a National Park or requires oil spill response activities to be conducted within a National Park	Vessel Master	Department of Environment and Energy	Reported verbally, as soon as practicable	Director of National Parks	Phone: 02 6274 2220
Activity causes unintentional death of or injury to fauna species listed as Threatened or Migratory under the EPBC Act	Vessel Master	Department of Environment and Energy	Within seven days of becoming aware	Secretary of the DoEE	Phone: 1800 803 772 Email: protected.species@environment.gov.au
Any oil pollution incident which has the potential to enter a WA State waters	CICC DM or delegate	WA Department of Transport	Marine Duty Manager to verbally notify DoT that a spill has occurred and request use of equipment stored in the Exmouth supply shed at Harold E Holt.	DoT Duty Officer	Phone: 08 9480 9924

Event	Responsibility	Notifiable party	Notification requirements	Contact	Contact detail
			Follow up with a written pollution reports as soon as practicable following verbal notification. Additionally DoT to be notified if spill is likely to extend into WA State waters. Request DoT to provide Liaison to WEL IMT.		

Additionally, the following pollution activity should also be reported to AMSA via RCC Australia by the Vessel Master:

- any loss of plastic material
- garbage disposed of in the sea within 12 nm of land (garbage includes food, paper, bottles, etc.)
- any loss of hazardous materials.

For oil spill incidents other agencies and organisations will be notified as appropriate to the nature and scale of the incident as per procedures and contact lists in the Woodside Oil Pollution Emergency Arrangements (Australia).

External incident reporting requirements required under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations including under subregulation 2.42, notices and reports of dangerous occurrences will be reported to NOPSEMA under the approved activity safety cases.

7.9 Emergency Preparedness and Response

7.9.1 Overview

Under Regulations 14(8) the implementation strategy must contain an Oil Pollution Emergency Plan (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 7-4**.

Table 7-4: Oil pollution and preparedness and response overview

Content	Environment Regulations Reference	Document / Section Reference
Details of (oil pollution response) control measures that will be used to reduce the impacts and risks of the activity to as low as reasonably practicable and an acceptable level	Regulation 13 (5), (6), 14 (3)	Oil Spill Preparedness and Response Mitigation Assessment for Nganhurra Facility Operations Cessation Environment Plan (**Appendix D**)
Description of the oil pollution emergency plan	Regulation 14 (8)	Environment Plan: **Section 7.9.1** and **7.9.2**. Woodside's oil pollution emergency plan has the following components: • Woodside Oil Pollution Emergency Arrangements (Australia) • Nganhurra Operations Cessation Oil Pollution First Strike Plan (**Appendix H**) • Oil Spill Preparedness and Response Mitigation Assessment for Nganhurra Facility Operations Cessation Environment Plan (**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 for Nganhurra Facility Operations Cessation Environment Plan (**Appendix D**) Nganhurra Operations Cessation Oil Pollution First Strike Plan (**Appendix H**)
Details the arrangements for the updating and testing the oil pollution response arrangements	Regulation 14 (8), (8A), (8B), (8C)	Environment Plan: **Section 7.9** Oil Spill Preparedness and Response Mitigation Assessment for Nganhurra Operations Cessation Environment Plan (**Appendix D**)
Details of provision, monitoring impacts to the environment from oil pollution and response activities	Regulation 14 (8D)	Oil Spill Preparedness and Response Mitigation Assessment for Nganhurra Operations Cessation Environment Plan (**Appendix D**)
Demonstrates that the oil pollution response arrangements are consistent with the national system for oil	Regulation 14 (8E).	Woodside Oil Pollution Emergency Arrangements (Australia)

Content	Environment Regulations Reference	Document / Section Reference
pollution preparedness and control.		

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 the positions required for effective oil spill response. Following the mapping of training to Woodside-identified competencies, training was then mapped to positions based on those required competencies (**Table 7-5**).

Table 7-5: Minimum levels of competency for key IMT positions

IMT Position	Competencies
CICC Leader and S&EM Duty Manager, Operations, Planning, Logistics, Safety	• Undertake the Incident Crisis Leadership Development Program • Participate in Level 2 oil spill exercise (initial) • Participate in Level 2 oil spill exercise (refresher) • Undertake Oil Spill Response Skills Enhancement Course (internal course) • Undertake ICC Fundaments Course (all CICC positions)

7.9.3 Emergency Response Preparation

The Corporate Incident Coordination Centre (CICC), based in Woodside's head office in Perth, is the onshore coordination point for an offshore emergency. The CICC is staffed an appropriately skilled team available on call 24 hours a day. The purpose of the team is to coordinate incidents rescues, 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 (Australia).

Woodside has an Emergency Response Plan (ERP) in place relevant to the Petroleum Activities Program. The ERP provides procedural guidance specific to the activity and location of operations to control, coordinate and respond to an emergency or incident. For a well intervention activity the ERP will be a bridging document to the contracted rigs emergency documentation. This document provides a summary of the emergency command, control and communications processes for the integrated operation and management of an emergency. It is developed in collaboration with the contracted rig and ensures roles and responsibilities between the contracted rig and Woodside personnel are identified and understood. The ERPs will contain instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification, contact information and activation of the Contractor's emergency centre and Woodside Communication Centre (WCC).

In the event of an emergency of any type:

- On the MODU the Offshore Installation Manager will assume overall onsite command and act as the Incident Controller (IC). All persons aboard the MODU/vessels will be required to act under the IC's directions. The MODU/vessels will maintain communications with the onshore Drilling Superintendent and/or other emergency services in the event of an emergency. Emergency response support can be provided by the Contractor's emergency centre or WCC if requested by the IC.
- Vessel Master (depending on the location of the emergency) will assume overall onsite command and act as the IC. All persons will be required to act under the IC's directions. The vessels will

maintain communications with the onshore project manager and/ or other emergency services in the event of an emergency. Emergency response support can be provided by the contractor's emergency centre or WCC if requested by the IC.

The project vessels will have on-board equipment for responding to emergencies including but not limited to medical equipment, fire-fighting equipment and oil spill response equipment.

7.9.4 Hydrocarbon 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 Nganhurra Operations Cessation Oil Pollution First Strike Plan, which provides operational response guidance to the activity/area and **Appendix D** of this EP, covers spill response for this Petroleum Activities Program (**Appendix H**).

The Security and Emergency Management Function is responsible for managing Woodside's hydrocarbon spill response equipment and for maintaining 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 Woodside Oil Pollution Emergency Arrangements (Australia). AMSA and Woodside have a Memorandum of Understanding in place to support Woodside in the event of an oil spill.

The Nganhurra Operations Cessation Oil Pollution First Strike Plan provides immediate actions required to commence a response (**Appendix H**).

Project vessels will have SOPEPs in accordance with the requirements of MARPOL 73/78 Annex I. These plans outline responsibilities, specify procedures and identify resources available in the event of a hydrocarbon or chemical spill from vessel activities. The Oil Pollution First Strike Plan is intended to work in conjunction with the SOPEPs, if hydrocarbons are released to the marine environment from a vessel.

Woodside has established environmental performance outcomes, performance standards and measurement criteria to be used for oil spill response during the Petroleum Activities Program, as detailed in **Appendix D**.

7.9.5 Emergency and Spill Response

Woodside categorises incidents and emergencies in relation to response requirements as follows:

7.9.5.1 Level 1

Level 1 incidents 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.

7.9.5.2 Level 2

Level 2 incidents are 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 ICC.

7.9.5.3 Level 3

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 ICC may also be activated as required to manage the operational incident response.

7.9.6 Emergency and Spill Response Drills and Exercises

Woodside's capability to respond to incidents will be tested periodically, in accordance with the Emergency and Crisis Management Procedure. The scope, frequency and objective of these tests is described in **Table 7-6**. Emergency response testing is aligned to existing or developing risks associated with Woodside's operations and activities. Corporate hazards/risks outlined in the corporate risk register, respective Safety Cases or project Risk Registers, are reference points developing and scheduling emergency and crisis management exercises. External participants may be invited to attend exercises (e.g. government agencies, specialist service providers, oil spill response organisations, or industry members with which Woodside has mutual aid arrangements).

The overall objective of exercises is to test procedures, skills and the teamwork of the Emergency Response and Command Teams in their ability to respond to major accident / major environment events. After each exercise, the team holds a debriefing session, during which the exercise is reviewed. Any lessons learned or areas for improvement are identified and incorporated into revised procedures, where appropriate.

Table 7-6: Testing of response capability

<table>
<tr><th>Response Category</th><th>Scope</th><th>Response Testing Frequency</th><th>Response Testing Objective</th></tr>
<tr><td>Level 1 Response</td><td>Exercises are project-/ activity-specific</td><td>One Level 1 oil spill response exercise to be conducted within two weeks of commencing:
• project activities
• each well intervention campaign.
One Level 1 emergency drill to be conducted per week, during the activity.</td><td>• Comprehensive exercises test elements of the Nganhurra Operations Cessation Oil Pollution First Strike Plan (Appendix H).
• Emergency drills are scheduled to test other aspects of the Emergency Response Plan.</td></tr>
<tr><td rowspan="2">Level 2 Response</td><td rowspan="3">Exercises are relevant to all Woodside assets</td><td>At least one emergency management exercise will be conducted every two years, except if a MODU is to be used for any activities, in which case at least one exercise per MODU will be conducted per year and one within one month of commencing a new activity in a new region.</td><td>• Testing both the facility IMT response and/or that of the CICC following handover of incident control.</td></tr>
<tr><td>An activity-specific exercise will be undertaken for the PIV during activities within Operational Area 2</td><td>• Test elements of the PIV response and interface with the Nganhurra Operations Cessation Oil Pollution First Strike Plan (Appendix H).</td></tr>
<tr><td>Level 3 Response</td><td>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.</td><td>• Test Woodside's ability to respond to and manage a crisis level incident.</td></tr>
</table>

7.9.7 Hydrocarbon Spill Response Testing of Arrangements

Woodside is required to test hydrocarbon spill response arrangements as per regulations 8B and 8C of the Environment Regulations. Woodside's arrangements for spill response are common across its Australian operating assets and activities to ensure the 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's processes and procedures and improvements are made where required.

If new response arrangements are introduced, or existing arrangements significantly amended, additional testing is undertaken accordingly. If the MODU leaves the field for an extended period, additional testing will be undertaken when it returns to routine operations. Additional activities or activity locations are not anticipated to occur; however, if 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 7-6**, up to eight formal exercises are planned annually, across Woodside, to specifically test arrangements for responding to a hydrocarbon spill to the marine environment.

7.9.7.1 Testing of Arrangements Schedule

Woodside's Testing of Arrangements Schedule (**Figure 7-1**) aligns with international good practice for spill preparedness and response management; the testing is compatible with the IPIECA Good Practice Guide and the Australian Emergency Management Institute Handbook. If a spill occurs, enacting these arrangements will underpin Woodside's ability to implement a response across its petroleum activities. **Figure 7-1** shows a condensed snapshot of Woodside's 5-year rolling Testing of Arrangements Schedule.

HSP TESTING OF ARRANGEMENTS SCHEDULE

WOODSIDE ID: 10058092

5 YEAR ROLLING SCHEDULE

Arrangement	Support Agency / Company	Area to be tested
1	WEL	Personnel
2	WEL	Equipment
3	WEL	Vessel aquistion - internal processes
4	AMOSC	Equipment
5	AMOSC	Personnel
6	OSRL	Equipment
7	OSRL	Personnel
8	Worley Parsons	Equipment
9	Worley Parsons	Personnel
10	ERM	Equipment
11	ERM	Personnel
12	Jacobs	Equipment
13	Jacobs	Personnel
14	AMSA	Equipment
15	AMSA	Personnel
16	DOT (Department of Transport)	Equipment
17	DOT (Department of Transport)	Staging Area Support
18	WEL	Predictive Modelling - Rapid Assessment Tool
19	RPS APASA	Predictive Modelling
20	KSAT	Satellite remote sensing
21	Bristows	Aircraft
22	MSRC	Personnel
23	Sci Aero	Equipment and Personnel
24	Centurion	Logistics Support
25	Harold E Holt	Support and Access
26	Fergusons	Equipment
27	Swires	Equipment
28	Toll Mermaid	Staging Area Support
29	Norwest Air Works	Dispersant Aircraft (access and support)
30	Exmouth Aerodrome	Dispersant Aircraft (access and support)
31	Broome International Airport	Dispersant Aircraft (access and support)
32	Learmonth Airport	Dispersant Aircraft (access and support)
33	Exmouth Freight and Logistics	Logistics Support
34	Veolia	Equipment and Personnel
35	ERS	Equipment and Personnel

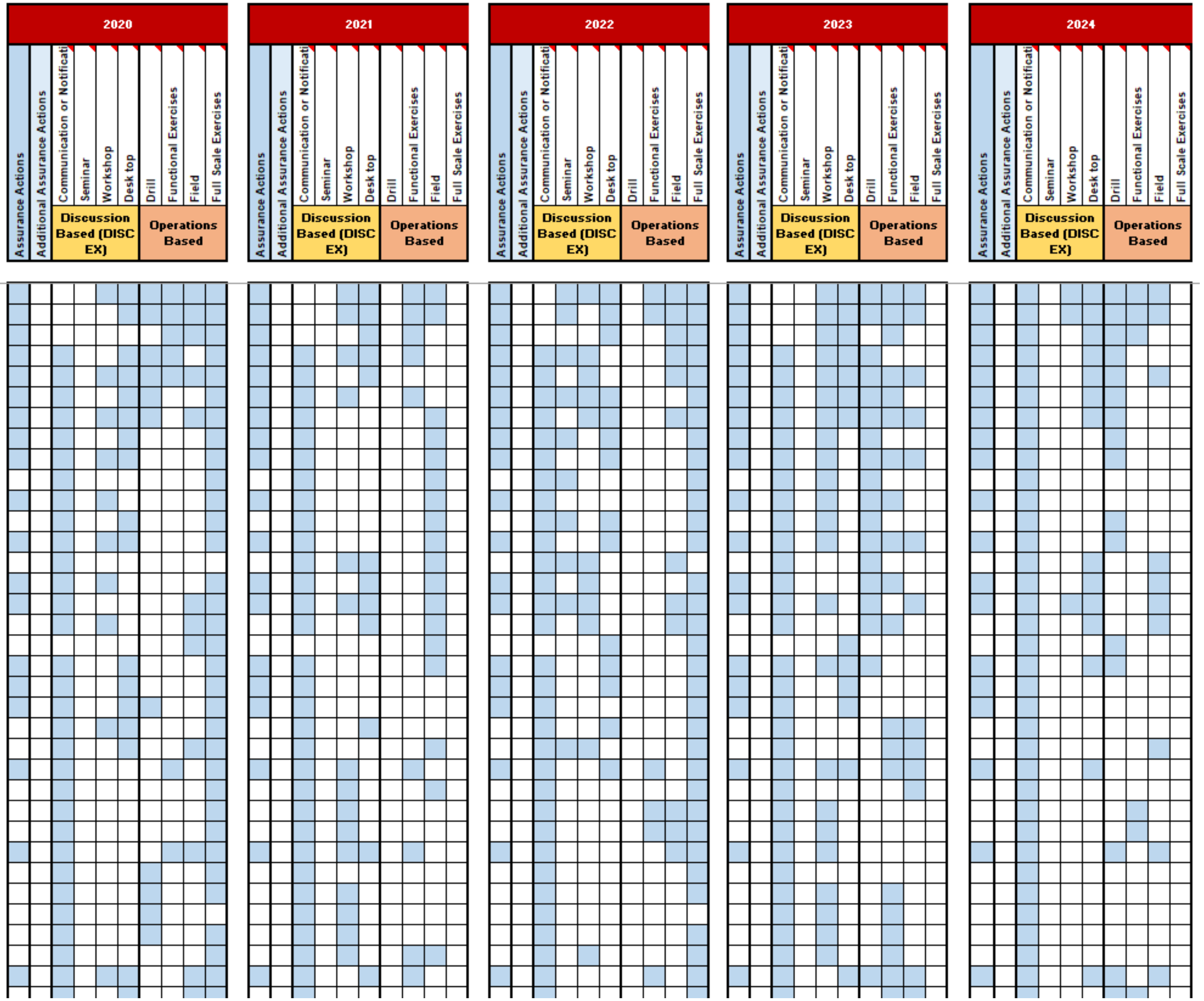

Figure 7-1: Indicative 5-yearly testing of arrangements schedule

(Snapshot of a selection of oil spill response arrangements tested annually; Note: schedule is subject to change, additional detail is included in the live document)

Numbered hydrocarbon spill arrangements listed in the rows of the schedule are taken from the 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 the Australian Marine Oil Spill Centre to provide response personnel and equipment. About 75 hydrocarbon spill preparedness arrangements are tested annually across the eight planned exercises, as described in **Section 7.9.6**.

The vertical columns under each year in **Figure 7-1** relate to an individual exercise or additional assurance actions that are conducted over the 5-year rolling schedule. The sub-heading for the column describes the standard method of testing (e.g. discussion exercise, desktop exercise), and the blue cells indicate the arrangements that could be tested for each method.

Arrangements in the schedule are tested at least once a year; however, some arrangements may be tested across multiple exercises (e.g. critical arrangements) or via other 'additional assurance' methods outside 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) (refer to the first and second vertical columns for each year in **Figure 7-1**).

7.9.7.2 Exercises, Objectives, and 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's First Strike Plans.

Objectives and KPIs for each exercise are determined by reviewing:

- the Testing of Arrangements Schedule, which identifies which arrangements can be tested for each testing method (**Section 7.9.7.1**)
- the objectives and KPIs master generic plan, which summarises 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) for different response strategies, and considers priority commitments and worst-cast spill scenarios
- actions undertaken from recommendations from 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. After 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 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 testing their own arrangements).

7.9.8 Cyclone and Dangerous Weather Preparation

As the timing of some activities associated with the Petroleum Activities Program are not yet determined, it is possible that project activities will overlap with the cyclone season (November to April, with most cyclones occurring between January and March). If undertaking activities within cyclone season, the Contractor must have a Cyclone Contingency Plan (CCP) in place outlining the processes and procedures that would be implemented during a cyclone event, which will be reviewed and accepted by Woodside.

Project vessels will receive daily forecasts from the BoM. If a cyclone (or severe weather event) is forecast, the path and its development will be plotted and monitored using the BoM data. If there is the potential for the cyclone (severe weather event) to affect the Petroleum Activities Program, the CCP will be actioned. If required, vessels can transit from the proposed track of the cyclone (severe weather event).

7.10 Implementation Strategy and Reporting Commitments Summary

Table 7-7 provides a summary of key components within the implementation strategy.

Table 7-7: Implementation strategy and reporting commitments summary

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-1 All crew will be aware of their roles and responsibilities regarding environmental risks throughout the Petroleum Activities Program.	**PS IS-1.1** All personnel are required to attend an induction before commencing work. These inductions cover health, safety and environmental requirements for the MODU and project vessels, and environmental information specific to the Petroleum Activities Program location.	**MC IS-1.1.1** Induction attendance records.
	PS IS-1.2 A pre-activity meeting will be held on the MODU and Primary Installation Vessels with relevant personnel before conducting the Petroleum Activities Program, focusing on any specific environmental sensitivities associated with the activity.	**MC IS-1.1.2** Pre-activity meeting attendance records and minutes.
	PS IS-1.3 During execution campaign, regular HSE meetings will be held on the MODU and project vessels which cover all crew. Recent environmental incidents will be reviewed, and awareness material presented regularly.	**MC IS-1.3.1** Attendance is recorded and lists retained on the MODU/project vessels.
	PS IS-1.4 The MODU Contractor and vessel contractors must have a CCP accepted by Woodside, outlining the processes and procedures that would be implemented during a cyclone event, if well intervention is to take place during cyclone season.	**MC IS-1.4.1** Record of Woodside-approved Contractor CCP in place prior to activities commencing.
PO IS-2 Woodside and its Contractors will perform a program of periodic monitoring during the Petroleum Activities Program – starting at mobilisation of each activity and continuing through the duration of each activity to activity completion.	**PS IS-2.1** Monitoring information will be collected using Woodside tools and systems	**MC-IS 2.1.1** Monitoring reports including daily reports, periodic reports, risk observation cards, environmental discharge reports
	PS IS-2.2 Periodic review of the Woodside Environmental Knowledge Management System to maintain currency of receptor knowledge.	**MC-IS 2.2.1** Review records Corporate Environment Baseline Database

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-3 Woodside will audit environmental performance.	**PS IS-3.1** Any newly contracted MODU will have a start-up or pre-mobilisation audit performed, if not previously contracted to Woodside within the last two years.	**MC IS-3.1.1** Woodside's start up or pre-mobilisation report for the MODU.
	PS IS-3.2 Offshore Woodside personnel must conduct a minimum of monthly environmental inspections.	**MC IS-3.2.1** Completed environmental inspection checklists.
	PS IS-3.3 Woodside Environmental Adviser (or delegate) must complete at least one quarterly environment audit during the Petroleum Activities Program.	**MC IS-3.3.1** Quarterly Environment Audit report.
	PS IS-3.4 A pre-mobilisation inspection/audit report will be conducted by a relevant person prior to the commencement of subsea installation and pre-commissioning scopes.	**MC IS-3.4.1** Completed pre-mobilisation inspection/audit report.
	PS IS-3.5 At least one operational compliance audit relevant to applicable EP commitments will be conducted by a Woodside environment adviser for the subsea campaign	**MC IS-3.5.1** Completed Operational Compliance Audit report.
	PS IS-3.6 Contractor-specific HSE audits will be conducted of the primary installation vessels and associated support vessels.	**MC IS-3.6.1** Completed HSE audits report.
	PS IS-3.7 Vessel-based HSE inspections will be conducted fortnightly by vessel HSE personnel	**MC IS-3.7.1** Completed HSE inspection checklists.
	PS IS-3.8 Audit findings relevant to continuous improvement of environmental performance will be tracked through the MODU or vessel compliance action register, a contractor register between the MODU operator or vessel contractor and Woodside.	**MC IS-3.8.1** MODU or vessel compliance action register records that demonstrate tracking of audit findings.
	PS IS-3.9 Marine assurance will be undertaken in accordance with Woodside's internal assurance process and is mandatory for all vessels hired for Woodside.	**MC IS-3.9.1** Records demonstrate marine assurance reviews conducted as required.
PO IS-4 Woodside employees and Contractors will report all environmental incidents and non-conformance with environmental performance outcomes and standards in this EP.	**PS IS-4.1** Non-conformances to be notified, investigated and reported in accordance with Woodside's event recording, investigation and learnings requirements.	**PS IS-4.1.1** Records demonstrate Non-conformances are notified, investigated and reported in accordance with Woodside's event recording, investigation and learnings requirements.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-5 Woodside will perform regular reviews to monitor environmental performance and share knowledge and learning.	**PS IS-5.1** Woodside is to hold quarterly HSE Review meetings.	**PS IS-5.1.1** Records demonstrate meetings reviewed HSE performance.
	PS IS-5.2 Woodside’s Drilling and Completions Environment Team is to perform six-monthly reviews of the effectiveness of the implementation strategy and associated tools	**PS IS-4.2.1** Records demonstrate six-monthly reviews of the effectiveness of the implementation strategy.
	PS IS-5.3 After action review conducted at the end of each well for learning and knowledge sharing, including review of environmental incidents as relevant.	**PS IS-5.3.2** After action review report
PO IS-6 Changes in activity scope, understanding of the environment and potential new advice from external stakeholders will be tracked and the EP updated as required.	**PS IS-6.2** Management of change relevant to this EP to be managed in accordance with Regulation 17 of the Environment Regulations	**PS IS-6.2.1** Records of minor revisions to the EP tracked in an MoC Register. Revision and resubmission of the EP as required.
PO IS-7 All internal and external reporting requirements relevant to this EP will be met.	**PS IS-7.1** Regular HSE meetings Monthly and quarterly HSE performance reports	**MC IS-7.1.1** HSE performance reports. Minutes of HSE meetings
	PS IS-7.2 Woodside will submit an environmental performance report to NOPSEMA (annually, with the first report submitted within 12 months of commencing the activity) .	**MC IS-7.2.1** Record of submission of environmental performance reports to NOPSEMA.
	PS IS-7.3 Woodside will submit a monthly recordable incident report to NOPSEMA.	**MC IS-7.3.1** Record of submission of monthly recordable incident report to NOPSEMA.
PO IS-8 All external notification requirements, as applicable to this EP, will be met.	**PS IS-8.1** Woodside will notify NOPSEMA and DMIRS of the commencement of the Petroleum Activities Program at least ten days before the activity commences. Woodside will notify NOPSEMA and DMIRS within ten days of completing the activity.	**MC IS-8.1.1** Record of notification to NOPSEMA. Record of notification to DMIRS.
	PS IS-8.2 The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended and all the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A.	**MC IS-8.2.1** Record of notification to NOPSEMA.
	PS IS-8.3 NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations.	**MC IS-8.3.1** Record of notifications to NOPSEMA

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
	PS IS-8.4 DoEE (if MNES affected) will be notified of oil spill incidents as soon as practicable following the occurrence.	**MC IS-8.4.1** Record of notification to DoEE if MNES is affected.
	PS IS-8.5 DPIRD, peak fishing bodies and known regional commercial fishing operators identified in this EP will be notified prior to and upon completing the proposed activity, including MODU and support vessel details.	**MC IS-8.5.1** Records of notification to the Department, peak fishing bodies and known commercial regional fishing operators identified in this EP.
	PS IS-8.6 Any oil pollution incidents in Commonwealth waters will be reported without delay (by the vessel master) to AMSA RCC as per the *Protection of the Sea (Prevention of Pollution from Ships) Act*, Part II, Section 11(1). The verbal report shall be made via the national emergency 24-hour notification contact, and if AMSA requests a written report, it should be provided within 24 hours of the request.	**MC IS 8.6.1** Records of notification to AMSA.
PO IS-9 Planned and unplanned emissions and discharges will be documented, and records maintained.	**PS IS-9.1** The volumes of planned and unplanned emissions and discharges that could result from the risks described in **Sections 6.6** and **6.6.1.2** are documented in the daily reports.	**MC IS-9.1.1** Records of planned and unplanned emissions and discharges are maintained in daily reports.
PO IS-10 Personnel holding responsibilities in a response will test the arrangements supporting the activities OPEP to ensure they are effective and communicated.	**PS IS-10.1** Exercises will be conducted in alignment with the frequency identified in **Table 7-4**. These arrangements are conducted in accordance with Regulation 14(8B) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.* • Arrangements are tested when introduced. • Arrangements are tested in accordance with Woodside's Hydrocarbon Spill Arrangements Testing Schedule as per the frequency identified in **Section 7.9** • Arrangements will be tested when the OPEP is significantly amended, and further testing will occur if a new activity location is added to the EP.	**MC IS-10.1.1** Spill response exercise reports and key participants maintained in the Woodside IMS system. Records managed in Hydrocarbon Spill Preparedness Unit (HSPU) Testing of Arrangements Register.
	PS IS-10.2 Post exercise reports will be developed for each exercise to measure performance against the objectives, and the learnings from the plan updated in the OPEP following these learnings.	**MC IS-10.2.1** Spill response exercise reports and key participants maintained in the Woodside IMS system. Records managed in HSPU Testing of Arrangements Register.
	PS IS-10.3 Close-out of HSPU actions from exercising are managed in the HSPU Testing of Arrangements Register.	**MC IS-10.3.1** Records managed in HSPU Testing of Arrangements Register.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-11 Woodside will ensure that the arrangements supporting the activities OPEP are validated.	**PS IS-11.1** Activity OPEPs will be revised at a minimum every five years.	**MC IS-11.1.1** OPEP current and available.
PO IS-12 The OPEP will only be updated under specific circumstances to ensure the information is current.	**PS IS-12.1** Relevant documents from the OPEP will be reviewed when: • implementing an improved preparedness measure • the availability of equipment stockpiles changes • the availability of personnel changes that reduces or improves preparedness and the capacity to respond • a new or improved technology is introduced that may be considered in a response for this activity • incorporating, where relevant, lessons learned from exercises or events • national or state response frameworks and Woodside's integration with these frameworks' changes.	**MC IS-12.1.1** The following records will be maintained: • Woodside's HSPU Testing of arrangements register • Woodside's Internal Equipment Maintenance Register • OPEP current and available.
PO IS-13 Woodside will perform a vessel risk assessment where an inspection and/or Verification Review is not available (i.e. short-term vessel hire).	**PS IS-13.1** The Marine Vessel Risk Assessment will be conducted by the Marine Assurance Superintendent, or the nominated deputy, where the vessel meets the short-term hire prerequisites.	**MC IS-13.1.1** Marine Vessel Risk Assessment sheet demonstrates the assessment has been conducted.
PO IS-14 Prior to recommencing activities after a cessation period greater than 12 months, Woodside will review impacts, risks and controls.	**PS IS-14.1** Impacts and risks associated with recommencing activities (if commencing after a cessation period greater than 12 months) must remain/be reduced to ALARP and acceptable levels.	**MC IS-14.1.1** Records demonstrate impacts, risks and controls are reviewed before recommencing activities (if commencing after a cessation period greater than 12 months).

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9 GLOSSARY AND ABBREVIATIONS

9.1 Glossary

Term	Meaning
(the) Regulator	The Government Agency (State or Commonwealth) that is the decision maker for approvals and undertakes ongoing regulation of the approval once granted.
Acceptability	The EP must demonstrate that the environmental impacts and risks of an activity will be of an acceptable level as per Regulation 10A(c).
ALARP	A legal term in Australian safety legislation, it is taken here to mean that all contributory elements and stakeholders have been considered by assessment of costs and benefits, and which identifies a preferred course of action
API (gravity)	is a measure of how heavy or light a petroleum liquid is compared to water
Australian Standard	An Australian Standard which provides criteria and guidance on design, materials, fabrication, installation, testing, commissioning, operation, maintenance, re-qualification and abandonment
Ballast	Extra weight taken on to increase a ship’s stability to prevent rolling and pitching. Most ships use seawater as ballast. Empty tank space is filled with inert (non-combustible) gas to prevent the possibility of fire or explosion
Bathymetry	Related to water depth – a bathymetry map shows the depth of water at a given location on the map
Benthos/Benthic	Relating to the seabed, and includes organisms living in or on sediments/rocks on the seabed
Biodiversity	Relates to the level of biological diversity of the environment. The EPBC Act defines biodiversity as: “the variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part) and includes: (a) diversity within species and between species; and (b) diversity of ecosystems”
Biota	The animal and plant life of a particular region, habitat, or geological period
Cetacean	Whale and dolphin species
Consequence	The worst-case credible outcome associated with the selected event assuming some controls (prevention and mitigation) have failed. Where more than one impact applies (e.g. environmental and legal/compliance), the consequence level for the highest severity impact is selected.
Coral	Anthozoa that are characterised by stone like, horny, or leathery skeletons (external or internal). The skeletons of these animals are also called coral
Coral Reef	A wave-resistant structure resulting from skeletal deposition and cementation of hermatypic corals, calcareous algae, and other calcium carbonate-secreting organisms
Crustacean	A large and variable group of mostly aquatic invertebrates which have a hard external skeleton (shell), segmented bodies, with a pair of often very modified appendages on each segment, and two pairs of antennae (e.g. crabs, crayfish, shrimps, wood lice, water fleas and barnacles)
Cyclone	A rapidly-rotating storm system characterised by a low-pressure centre, strong winds, and a spiral arrangement of thunderstorms that produce heavy rain
dB	Decibel – this is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (that is, ‘A’ weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies
dB re 1 µPa (RMS)	Measure of underwater noise, in terms of sound pressure. Because the dB is a relative measure, rather than an absolute measure, it must be referenced to a standard “reference intensity”, in this case 1 micro Pascal (1 µPa), which is the standard reference that is used. The dB is also measured over a specified frequency, which is usually either a one Hertz bandwidth (expressed as dB re 1 $\mu Pa^2/Hz$), or over a broadband which has not been filtered. Where a frequency is not specified, it can be assumed that the measurement is a broadband measurement

Term	Meaning
dB re 1 μPa².s	Normal unit for sound exposure level
Demersal	Living close to the floor of the sea (typically of fish)
DRIMS	Woodside's internal document management system.
Dynamic positioning	In reference to a marine vessel that uses satellite navigation and radio transponders in conjunction with thrusters to maintain its position
EC50	the concentration of a drug, antibody or toxicant which induces a response halfway between the baseline and maximum after a specified exposure time
Echinoderms	Any of numerous radially symmetrical marine invertebrates of the phylum Echinodermata, which includes the starfishes, sea urchins, and sea cucumbers, which have an internal calcareous skeleton and often covered with spines
Endemic	A species that is native to, or confined to a certain region
Environment	The surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interrelations (Source: ISO 14001).
Environment Plan	Prepared in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, which must be assessed and accepted by the Designated Authority (NOPSEMA) before any petroleum-related activity can be carried out
Environment Regulations	OPGGS (Environment) Regulation 2020
Environmental approval	The action of approving something, which has the potential to have an adverse impact on the environment. Environmental impact assessment is generally required before environmental approval is granted.
Environmental Hazard	The characteristic of an activity or event that could potentially cause damage, harm or adverse effects on the environment
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services (Source: HB 203:2006).
Environmental impact assessment	An orderly and systematic process for evaluating a proposal or scheme (including its alternatives), and its effects on the environment, and mitigation and management of those effects (Source: Western Australian Environmental Impact Assessment Administrative Procedures, 2010).
EPBC Act	Environment Protection and Biodiversity Conservation Act, 1999. Commonwealth legislation designed to promote the conservation of biodiversity and protection of the environment.
Epifauna	Benthic animals that live on the surface of a substrate
Fauna	Collectively, the animal life of a particular region
Infauna	Aquatic animals that live in the substrate of a body of water, especially in a soft sea bottom
ISO 14001	ISO 14001 is an international standard that specifies a process (called an Environmental Management System [EMS]) for controlling and improving a company's environmental performance. An EMS provides a framework for managing environmental responsibilities so that they become more efficient and more integrated into overall business operations.
LC50	The concentration of a substance that is lethal to 50% of the population exposed to it for a specified time.
Likelihood	The description that best fits the chance of the selected consequence actually occurring, assuming reasonable effectiveness of the prevention and mitigation controls.

Term	Meaning
MARPOL (73/78)	The International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978. MARPOL 73/78 is one of the most important international marine environmental conventions. It was designed to minimise pollution of the seas, including dumping, oil and exhaust pollution. Its stated object is to preserve the marine environment through the complete elimination of pollution by oil and other harmful substances and the minimization of accidental discharge of such substances
Meteorology	The study of the physics, chemistry, and dynamics of the earth's atmosphere, including the related effects at the air–earth boundary over both land and the oceans.
Mitigation	Management measures which minimise and manage undesirable consequences
pH	measure of the acidity or basicity of an aqueous solution
Protected Species	Threatened, vulnerable or endangered species which are protected from extinction by preventive measures. Often governed by special federal or state laws
Putrescible	Refers to food scraps and other organic waste associated with food preparation that will be subject to decay and rot (putrefaction)
Risk	The combination of the consequences of an event and its associated likelihood. For guidance see Environmental Guidance on Application of Risk Management Procedure
Sessile	Organism that is fixed in one place; immobile
Thermocline	A temperature gradient in a thermally stratified body of water
Zooplankton	Plankton consisting of small animals and the immature stages of larger animals

9.2 Abbreviations

Abbreviation	Meaning
~	Approximately
°C	Degrees Celsius
µm	Micrometre
ABN	Australian Business Number
ACN	Australian Company Number
ACS	Australian Customs Service
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AHT	Anchor-handling Tug
AIMS	Australian Institute of Marine Science
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
RPS APASA	RPS Asia Pacific Applied Science Associates
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
ATSB	Australian Transport Safety Bureau
AU$	Australian dollar
AUSCOAST	Australian Coastal (weather warning)
bbl	Barrel (oil)
BCF	Bioconcentration Factor
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BOP	Blow-out Preventer
CALM	Former Western Australian Department of Conservation and Land Management (now DBCA) (CALM dates: from 22 Mar 1985 to 30 Jun 2006)
CCG	Cape Conservation Group
CCP	Cyclone Contingency Plan
CEFAS	Centre for Environment, Fisheries and Aquaculture Science (UK)
CFA	Commonwealth Fisheries Association
CICC	Corporate Incident Communication Centre
cm^3	Cubic centimetre
CMR	Commonwealth Marine Reserve
CMT	Crisis Management Team

Abbreviation	Meaning
CoG	Centre of Gravity
cP	Centipoise
CS	Cost/Sacrifice
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CV	Company Values
DAF	Dynamic Amplification Factor
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DAWR	Former Commonwealth Department of Agriculture, Water and Resources (now Department of Agriculture, Water and the Environment [DAWE]; DAWR dates: from 21 Sep 2015 to 29 May 2019; DAWE dates: from 1 Feb 2020 to [ongoing])
dB	Decibel
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DEWHA	Former Commonwealth Department of the Environment, Water, Heritage and the Arts (now Department of Agriculture, Water and the Environment [DAWE] from 1 Feb 2020) (DEWHA dates: from 3 Dec 2007 to 14 Sep 2010)
DGPS	Differential Global Positioning System
DIIS	Former Commonwealth Department of Industry, Innovation and Science (from 21 Sept 2015 to 31 Jan 2020; now Department of Industry, Science, Energy and Resources [from 1 Feb 2020])
DISER	Commonwealth Department of Industry, Science, Energy and Resources (from 1 Feb 2020; incorporates previous DIIS, energy functions from DoEE and small business functions from Department of Employment, Skills, Small and Family Business)
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety (from 1 July 2017 to [ongoing]; formerly Department of Mines and Petroleum [DMP])
DMP	Former Western Australian Department of Mines and Petroleum (now Department of Mines, Industry Regulation and Safety [DMIRS] [from 1 July 2017]; DMP dates: 1 January 2009 to 1 July 2017)
DNP	Director of National Parks
DNV	Det Norske Veritas
DoD	Commonwealth Department of Defence
DoEE	Former Commonwealth Department of the Environment and Energy (formerly Department of the Environment and Water; Department of the Environment, Water, Heritage and the Arts [DEWHA]; and Department of Sustainability, Environment, Water, Population and Communities [SEWPaC]) (DoEE dates: from 19 Jul 2016 to 31 Jan 2020) (Energy functions split from this department and incorporated into the Department of Industry, Science, Energy and Resources [DISER] 1 Feb 2020) (Environment functions split from this department in incorporated into the Department of Agriculture, Water and the Environment [DAWE] 1 Feb 2020)
DoF	Former Western Australian Department of Fisheries (now DPIRD [from 1 July 2017])
DOI	Digital Object Identifier; a string of numbers, letters and symbols used to permanently identify and link to an article or document on the internet
DoT	Western Australian Department of Transport
DP	Dynamic Positioning; a computer-controlled system to automatically maintain a vessel's position and heading by using its propellers and thrusters
DPIRD	Western Australian Department of Primary Industries and Regional Development (formerly Department of Agriculture and Food, Department of Fisheries, and Department of Regional Development and Lands) (from 1 Jul 2017 to [ongoing])

Abbreviation	Meaning
DPLH	Western Australian Department of Planning, Lands and Heritage (formerly Department of Planning, Department of Lands, State Heritage Office, and Department of Aboriginal Affairs) (from 1 July 2017 to [ongoing])
DSEWPaC	Former Commonwealth Department of Sustainability, Environment, Water, Population and Communities (formerly Department of the Environment and Water; Department of the Environment, Water, Heritage and the Arts [DEWHA]; now DAWE) (DSEWPaC dates: 14 Sep 2010 to 18 Sep 2013)
DWS	Diamond Wire Saw
EC50	half maximal effective concentration
ECCI	Exmouth Chamber of Commerce and Industry
EDS	Emergency Disconnect Sequence
EEZ	Exclusive Economic Zone
EHU	Electro-hydraulic Umbilical
EMBA	Environment that May Be Affected
EMS	Environmental Management System
ENVID	Environmental hazard Identification
EP	Environment Plan
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPO	Environmental Performance Objective / Outcome
EPS	Environmental Performance Standard
ERP	Emergency Response Plan
ESD	Ecological Sustainable Development
FAO	define
FPSO	Floating Production, Storage and Offtake (vessel)
FRDC	Fisheries Research and Development Corporation
Fy	Yield stress
g	Gram
g/m^2	Grams per square metre
GDSF	Gascoyne Demersal Scalefish Fishery
GP	Good Practice
ha	Hectare
HAZID	Hazard Identification
HCV	Heavy Construction Vessel
HLV	Heavy Lift Vessel
HMAS	His Majesty's Australian Ship (during World War II)
HOCNF	Harmonised offshore chemical notification format
HQ	Hazard Quotient
Hs	Significant wave height
HSE	Health, Safety and Environment
HSK	Ship of the German Navy (during World War II)
HSPU	Hydrocarbon Spill Preparedness Unit
Hz	Hertz

Abbreviation	Meaning
IAP	Incident Action Plan
IAR	Integrated Artificial Reef
IC	Incident Controller
ICC	Incident Coordination Centre
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMMR	Inspection, Monitoring, Maintenance and Repair
IMO	International Maritime Organization
IMS	Invasive Marine Species
IMT	Icident Management Team
IPIECA	International Petroleum Industry Environmental Conservation Association
IS	Implementation Strategy
ISO	International Organization for Standardization
ITF	Indonesian Throughflow
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
JRCC	AMSA's Joint Rescue Coordination Centre
JSA	Job Safety Analysis
KEF	Key Ecological Feature
km	Kilometre
KPI	Key Performance Indicator
L	Litre
LAT	Lowest Astronomical Tide
LC50	Lethal concentration, 50%
LCS	Legislation, Codes and Standards
LNG	Liquefied Natural Gas
LTMP	Long-term Monitoring Plan
m	Metre
m/s	Metres per second
m^3	Cubic metre
MC	Measurement Criteria
MEG	Monoethylene glycol
MFO	Marine Fauna Observer
MGO	Marine Gas Oil
mm	Millimetre
MMSI	Maritime Mobile Service Identity
MNES	Matters of National Environmental Significance
MoC	Management of Change
MODU	Mobile Offshore Drilling Unit
MPA	Marine Protected Area
MSIN	Maritime Safety Information Notifications

Abbreviation	Meaning
N/A	Not Applicable
NASA	National Aeronautics and Space Administration (US)
NERA	National Energy Resources Australia
NGA	Nganhurra
NIMS	Non-indigenous Marine Species
NLPG	National Light Pollution Guidelines
nm	Nautical mile (1852 m); a unit of distance on the sea
NMFS	National Marine Fisheries Service (division of NOAA)
NOAA	National Oceanic and Atmospheric Administration
NOEC	No-observed-effect concentration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NORM	Naturally Occurring Radioactive Material
NTM	Notices to Mariners
NWBM	Non water-based muds
NWMR	North-west Marine Region
NWS	North West Shelf
NZS	New Zealand Standard
OCNS	Offshore Chemical Notification Scheme
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OIW	Oil in Water
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006*
OSPAR	Oslo and Paris Commission for the Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic Aromatic Hydrocarbon
PDSF	Pilbara Demersal Scalefish Fishery
PENV	Pendoley Environmental Pty Ltd
PFTIMF	Pilbara Fish Trawl (Interim) Managed Fishery
PIV	Primary Installation Vessel
PJ	Professional Judgement
PLF	Pilbara Line Fishery
PLONOR	Pose Little or No Risk
PMDI	Polymeric methylene diphenyl diisocyanate
PMST	Protected Matters Search Tool
PoS	Probability of Success
PPA	Pearl Producers Association
ppb	Parts Per Billion
ppm	Parts Per Million

Abbreviation	Meaning
PRV	Pressure Relief Valve
PS	Performance Standard
PSU	Practical Salinity Unit, equivalent to parts per thousand
PTMF	Pilbara Trap Managed Fishery
PTS	Permanent Threshold Shift
PTW	Permit To Work
PVC	Polyvinyl chloride
Q1, Q2 etc.	Three-month quarter of a calendar year
qPCR	Quantitative polymerase chain reaction
RBA	Risk-based Analysis
RBI	Risk-based Inspection
RCC	Rescue Coordination Centre
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
RTM	Riser Turret Mooring
scf	Standard cubic feet
SCSSSV	Surface Controlled Sub-surface Safety Valve
SIMAP	Spill Impact Mapping and Analysis Program
SIMOPS	Simultaneous Operations
SMP	Scientific Monitoring Program
SMPEP	Spill Monitoring Programme Execution Plan
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SV	Societal Values
TAP	Threat Abatement Plan
TBT	Tributyltin
TC	Technical Complexity
TEG	Triethylene glycol
TPH	Total Petroleum Hydrocarbon
TTS	Temporary Threshold Shift
UK	United Kingdom
US	United States
US EPA	US Environmental Protection Agency
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WA	Western Australia
WAF	Water Accommodated Fraction
WAFIC	Western Australian Fishing Industry Council
WCC	Woodside Communication Centre
WEL	Woodside Energy Ltd

Abbreviation	Meaning
WHA	World Heritage Area
WHP	World Heritage Property
WLSADS	Woodside Well Location and Site Appraisal Data Sheet
WMS	Woodside Management System
WOMP	Well Operations Management Plan
Woodside	Woodside Energy Ltd
XLPE	Crosslinked polyethylene

APPENDIX A: WOODSIDE ENVIRONMENT AND RISK MANAGEMENT POLICIES

Woodside

Health, Safety, Environment and Quality Policy

OBJECTIVES

Strong health, safety, environment and quality (HSEQ) performance is essential for the success and growth of our business. Our aim is to be recognised as an industry leader in HSEQ through managing our activities in a sustainable manner with respect to our workforce, our communities and the environment.

At Woodside we believe that process and personal safety related incidents, and occupational illnesses, are preventable. We are committed to managing our activities to minimise adverse health, safety or environmental impacts, incorporating a right first time approach to quality.

PRINCIPLES

Woodside will achieve this by:

- implementing a systematic approach to HSEQ risk management
- complying with relevant laws and regulations and applying responsible standards where laws do not exist
- setting, measuring and reviewing objectives and targets that will drive continuous improvement in HSEQ performance
- embedding HSEQ considerations in our business planning and decision making processes
- integrating HSEQ requirements when designing, purchasing, constructing and modifying equipment and facilities
- maintaining a culture in which everybody is aware of their HSEQ obligations and feels empowered to speak up and intervene on HSEQ issues
- undertaking and supporting research to improve our understanding of HSEQ and using science to support impact assessments and evidence based decision making
- taking a collaborative and pro-active approach with our stakeholders
- requiring contractors to comply with our HSEQ expectations in a mutually beneficial manner
- publicly reporting on HSEQ performance

APPLICATION

Responsibility for the application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control. Woodside managers are also responsible for promotion of this policy in non-operated joint ventures.

This policy will be reviewed regularly and updated as required.

Reviewed in December 2019

APPROVED

Risk Management Policy

OBJECTIVES

Woodside recognises that risk is inherent to its business and that effective management of risk is vital to delivering on our objectives, our success and our continued growth. We are committed to managing all risk in a proactive and effective manner.

Our approach to risk enhances opportunities, reduces threats and sustains Woodside's competitive advantage.

The objective of our risk management system is to provide a consistent process for the recognition and management of risks across Woodside's business. The success of our risk management system lies in the responsibility placed on everyone at all levels to proactively identify, manage, review and report on risks relating to the objectives they are accountable for delivering.

PRINCIPLES

Woodside achieves these objectives by:

- Applying a structured and comprehensive risk management system across Woodside which establishes common risk management understanding, language and methodology
- Identifying, assessing, monitoring and reporting risks to provide management and the Board with the assurance that risks, including contemporary and emerging risks, are being effectively identified and managed, and that Woodside is operating with due regard to the risk appetite set by the Board
- Ensuring risks consider impacts across the following key areas of exposure: health and safety, environment, finance, reputation and brand, legal and compliance, and social and cultural
- Understanding our exposure to risk and applying this to our decision making
- Embedding risk management into our critical business activities and processes
- Assuring the effectiveness of risk controls and of the risk management process
- Building our internal resilience to the effects of adverse business impacts in order to sustain performance.

APPLICATION

The Managing Director of Woodside is accountable to the Board of Directors for ensuring this policy is effectively implemented.

Managers are responsible for promoting and applying the Risk Management Policy. Responsibility for the effective application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control.

This policy will be reviewed regularly and updated as required.

Revised by the Woodside Petroleum Ltd Board on 6 December 2019.

APPROVED

APPENDIX B: RELEVANT REQUIREMENTS

This appendix refers to Commonwealth Legislation related to the project. Western Australian State Legislation relevant to an accidental release of hydrocarbons in WA State waters is outlined in the Julimar Phase 2 Drilling and Subsea Installation Oil Pollution Emergency Plan.

Commonwealth Legislation	Legislation Summary
Air Navigation Act 1920 • *Air Navigation Regulations 1947* • *Air Navigation (Aerodrome Flight* • *Corridors) Regulations 1994* • *Air Navigation (Aircraft Engine* • *Emissions) Regulations 1995* • *Air Navigation (Aircraft Noise)* • *Regulations 1984* • *Air Navigation (Fuel Spillage) Regulations 1999*	This Act relates to the management of air navigation.
Australian Maritime Safety Authority Act 1990	This Act establishes a legal framework for the Australian Maritime Safety Authority (AMSA), which represents the Australian Government and international forums in the development, implementation and enforcement of international standards including those governing ship safety and marine environment protection. AMSA is responsible for administering the Marine Orders in Commonwealth waters.
Australian Radiation Protection and Nuclear Safety Act 1998	This Act relates to the protection of the health and safety of people, and the protection of the environment from the harmful effects of radiation.
Biosecurity Act 2015 • *Quarantine Regulations 2000* • *Biosecurity Regulation 2016* • *Australian Ballast Water Management Requirements 2017*	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. This Act includes mandatory controls on the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The Regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers.
Environment Protection and Biodiversity Conservation Act 1999 • *Environment Protection and Biodiversity Conservation Regulations 2000*	This Act protects matters of national environmental significance (NES). It streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and culturally significant places. Under this Act, actions that may be likely to have a significant impact on matters of NES must be referred to the Commonwealth Environment Minister.
Environment Protection (Sea Dumping) Act 1981 • *Environment Protection (Sea Dumping) Regulations 1983*	This Act provides for the protection of the environment by regulating dumping matter into the sea, incineration of waste at sea and placement of artificial reefs.
Industrial Chemicals (Notification and Assessment Act) 1989 • *Industrial Chemicals (Notification and Assessment) Regulations 1990*	This Act creates a national register of industrial chemicals. The Act also provides for restrictions on the use of certain chemicals which could have harmful effects on the environment or health.

Commonwealth Legislation	Legislation Summary
National Environment Protection Measures (Implementation) Act 1998 • *National Environment Protection Measures (Implementation) Regulations 1999*	This Act and Regulations provide for the implementation of National Environment Protection Measures (NEPMs) to protect, restore and enhance the quality of the environment in Australia and ensure that the community has access to relevant and meaningful information about pollution. The National Environment Protection Council has made NEPMs relating to ambient air quality, the movement of controlled waste between states and territories, the national pollutant inventory, and used packaging materials.
National Greenhouse and Energy Reporting Act 2007 • *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	This Act and associated Rule establishes the legislative framework for the NGER scheme for reporting greenhouse gas emissions and energy consumption and production by corporations in Australia.
Navigation Act 2012 • *Marine order 12 – Construction – subdivision and stability, machinery and electrical installations* • *Marine order 30 - Prevention of collisions* • *Marine order 47 - Mobile offshore drilling units* • *Marine order 57 - Helicopter operations* • *Marine order 60 - Floating offshore facilities* • *Marine order 91 - Marine pollution prevention—oil* • *Marine order 93 - Marine pollution prevention—noxious liquid substances* • *Marine order 94 - Marine pollution prevention—packaged harmful substances* • *Marine order 96 - Marine pollution prevention—sewage* • *Marine order 97 - Marine pollution prevention—air pollution*	This Act regulates navigation and shipping including Safety of Life at Sea (SOLAS). The Act will apply to some activities of the MODU and project vessels. This Act is the primary legislation that regulates ship and seafarer safety, shipboard aspects of marine environment protection and pollution prevention.
Offshore Petroleum and Greenhouse Gas Storage Act 2006 • *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* • *Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011* • *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009*	This Act is the principal Act governing offshore petroleum exploration and production in Commonwealth waters. Specific environmental, resource management and safety obligations are set out in the Regulations listed.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 • *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995*	This Act provides for measures to protect ozone in the atmosphere by controlling and ultimately reducing the manufacture, import and export of ozone depleting substances (ODS) and synthetic greenhouse gases, and replacing them with suitable alternatives. The Act will only apply to Woodside if it manufactures, imports or exports ozone depleting substances.

Commonwealth Legislation	Legislation Summary
Protection of the Sea (Powers of Intervention) Act 1981	This Act authorises the Commonwealth to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships and provides legal immunity for persons acting under an AMSA direction.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 *Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994* • *Marine order 91 - Marine pollution prevention—oil* • *Marine order 93 - Marine pollution prevention—noxious liquid substances* • *Marine order 94 - Marine pollution prevention—packaged harmful substances* • *Marine order 95 - Marine pollution prevention—garbage* • *Marine order 96 - Marine pollution prevention—sewage* *Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007* MARPOL Convention	This Act relates to the protection of the sea from pollution by oil and other harmful substances discharged from ships. Under this Act, discharge of oil or other harmful substances from ships into the sea is an offence. There is also a requirement to keep records of the ships dealing with such substances. The Act applies to all Australian ships, regardless of their location. It applies to foreign ships operating between 3 nautical miles (nm) off the coast out to the end of the Australian Exclusive Economic Zone (200 nm). It also applies within the 3 nm of the coast where the State/Northern Territory does not have complementary legislation. All the Marine Orders listed, except for Marine Order 95, are enacted under both the *Navigation Act 2012* and the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This Act is an amendment to the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This amended Act provides the protection of the sea from pollution by oil and other harmful substances discharged from ships.
Protection of the Sea (Harmful Antifouling Systems) Act 2006 • *Marine order 98—(Marine pollution prevention—anti-fouling systems)*	This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the application or reapplication of harmful anti-fouling compounds on Australian ships or foreign ships that are in an Australian shipping facility.

APPENDIX C: EPBC ACT PROTECTED MATTERS SEARCH

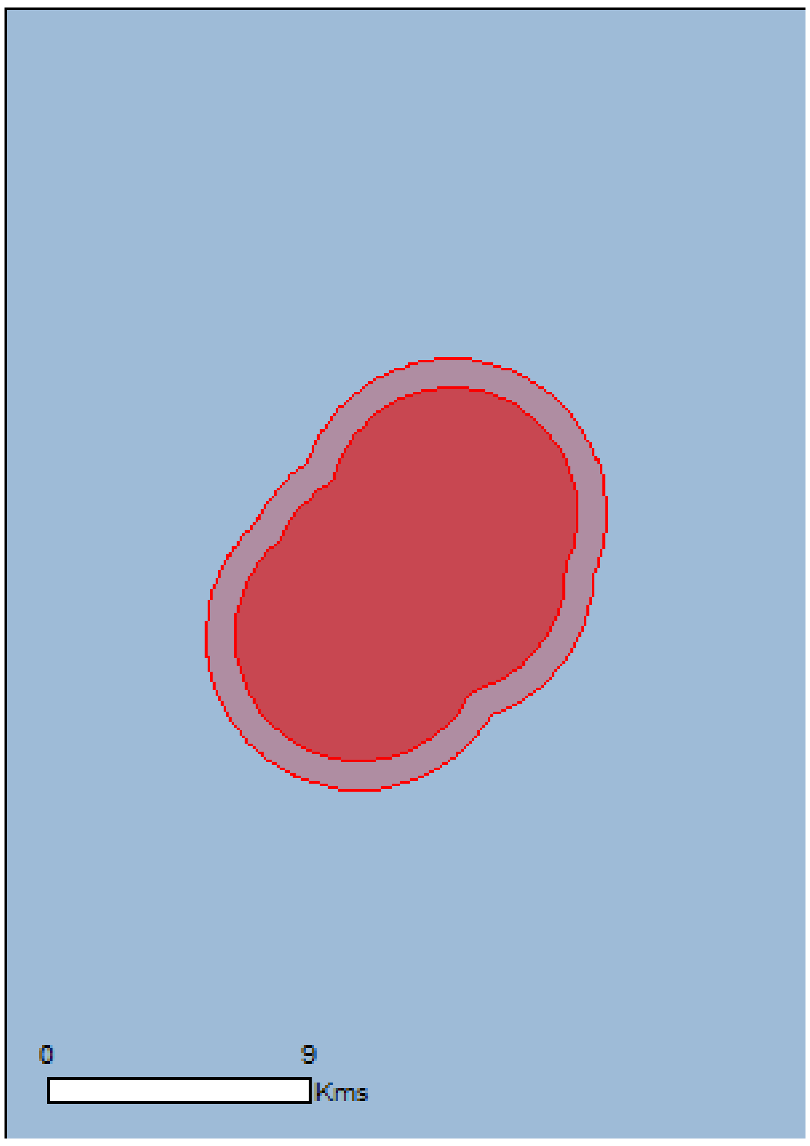
EPBC Act Protected Matters Report

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.

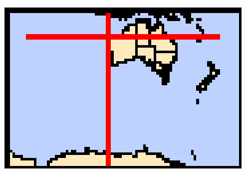
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 10/09/19 16:29:06



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	31

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	28
Whales and Other Cetaceans:	27
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	2

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	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	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur

Name	Threatened	Type of Presence
		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	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat 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
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation 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
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		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
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat 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
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely 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 likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known 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
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within 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
Canyons linking the Cuvier Abyssal Plain and the	North-west
Continental Slope Demersal Fish Communities	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

-21.5371578353 113.962491167,-21.5369905093 113.960012023,-21.5366641732 113.957548868,-21.5361956065 113.955108694,-21.5355772586 113.952702256,-21.5348119191 113.950338318,-21.5339064121 113.948024579,-21.532852064 113.945774624,-21.5316673025 113.943590613,-21.5303356129 113.941492859,-21.5288834543 113.939476664,-21.5272907571 113.937569499,-21.5255880766 113.935759867,-21.5237561867 113.934081154,-21.5218259671 113.932516556,-21.519782878 113.931102502,-21.5176550834 113.929819631,-21.5154353559 113.928703214,-21.5131473203 113.927734939,-21.5107919289 113.926944042,-21.5083879753 113.926317059,-21.505943464 113.925872529,-21.5034735934 113.925605075,-21.5009904904 113.925519045,-21.4985081801 113.925619143,-21.496038818 113.925893977,-21.4935982215 113.926358605,-21.4911942696 113.926986687,-21.4888472972 113.927802103,-21.4865582394 113.928768311,-21.4843512041 113.929909641,-21.4822218994 113.931189923,-21.4801943409 113.932626121,-21.4782618663 113.934187728,-21.4764477259 113.935885562,-21.4747418851 113.937692052,-21.4731411038 113.9395816,-21.4709267836 113.940708346,-21.4687900836 113.941976469,-21.466755163 113.943402085,-21.4648129757 113.944951823,-21.4629911327 113.946641346,-21.4612747227 113.948437959,-21.4596924197 113.950353678,-21.4582266595 113.952360036,-21.4569038056 113.954463268,-21.4551023188 113.95590521,-21.4527645176 113.956746639,-21.4504953239 113.957758074,-21.4482996345 113.958921005,-21.4461958752 113.960242694,-21.4441822849 113.961698395,-21.4422802535 113.963296922,-21.4404823074 113.965011892,-21.4388017163 113.966841794,-21.4372410865 113.968775223,-21.435811467 113.970807239,-21.4345141071 113.972926356,-21.4333528922 113.975122866,-21.4323345721 113.977389345,-21.4314533696 113.979712468,-21.4307253098 113.982088175,-21.430131888 113.984501041,-21.4297014874 113.986948295,-21.4294057353 113.989415428,-21.4292720354 113.991896552,-21.4292790135 113.994381307,-21.4294405824 113.996860685,-21.429750212 113.999326071,-21.4302058536 114.001768571,-21.4308152207 114.00417745,-21.4315615002 114.006547438,-21.4324645995 114.008862289,-21.4334959584 114.011122938,-21.4346826177 114.013306045,-21.4359923357 114.015417595,-21.4374458178 114.017432763,-21.4390178992 114.019356924,-21.4407052242 114.021180632,-21.4425097861 114.022888601,-21.4444241786 114.024472135,-21.4464434749 114.025919868,-21.4485576065 114.027224742,-21.4507579254 114.028378858,-21.4530351791 114.029371939,-21.4553763793 114.030203871,-21.4577731297 114.030857904,-21.4602093742 114.031345833,-21.4626761696 114.031641736,-21.4651573973 114.031771951,-21.4676410358 114.031701019,-21.4701141247 114.031463587,-21.4725613177 114.031033958,-21.4749726884 114.030436141,-21.4773328239 114.029659569,-21.4796322095 114.028718897,-21.4819399777 114.027940516,-21.4844225104 114.027838399,-21.4868916033 114.027561964,-21.4893360083 114.027116841,-21.4917396582 114.026488661,-21.4940948751 114.025697236,-21.4963824602 114.024727862,-21.4986019579 114.023610979,-21.5007291721 114.022327113,-21.5027719832 114.020912648,-21.5047015032 114.019347158,-21.5065330699 114.017668085,-21.5082349367 114.015857662,-21.5098272608 114.013950179,-21.511278494 114.011933298,-21.5126097549 114.009835268,-21.5137934769 114.00765068,-21.5148473333 114.005400492,-21.5157516849 114.003086293,-21.5165164629 114.000722173,-21.5177053052 113.998553158,-21.5197538366 113.997190581,-21.521794504 113.995773099,

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Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

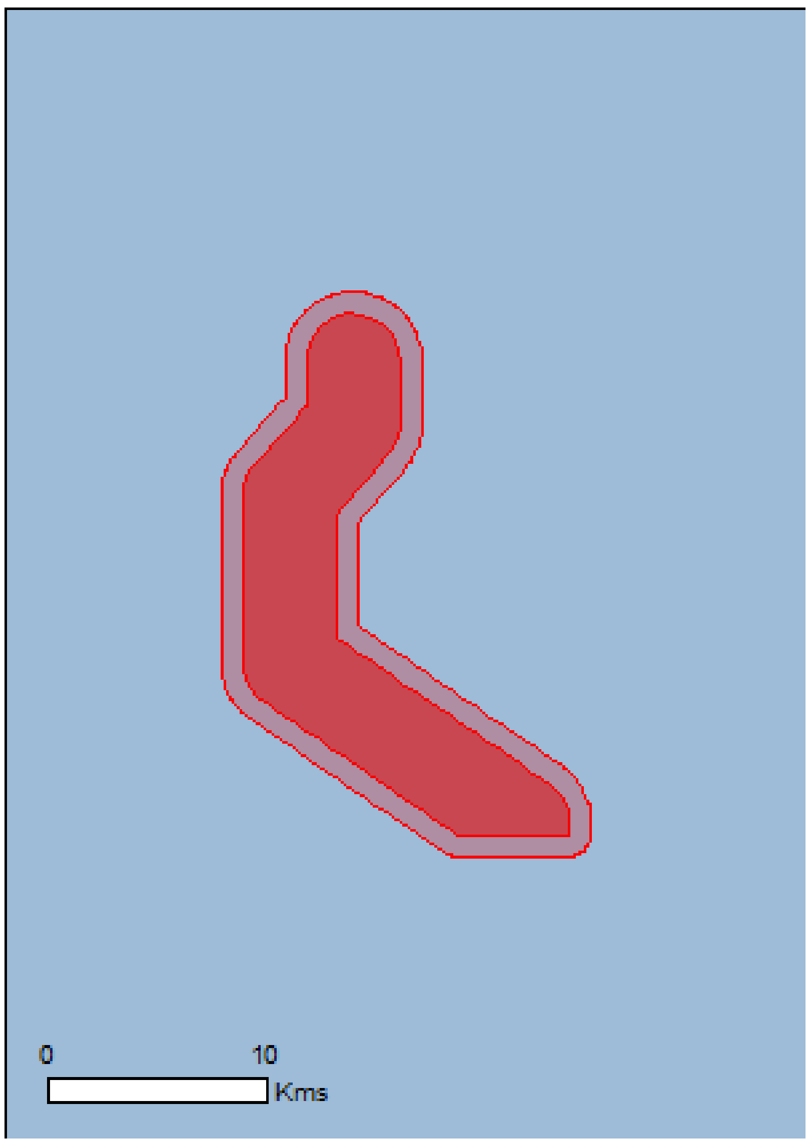
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

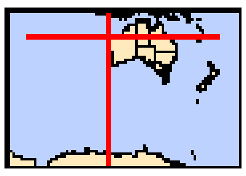
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 22/07/20 18:05:05



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	22
Listed Migratory Species:	35

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:	50
Whales and Other Cetaceans:	26
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	3

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

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Congregation or aggregation known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed		Species or species

Name	Threatened	Type of Presence
Shearwater [82404]		habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely 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 likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Congregation or aggregation known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Congregation or aggregation 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
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		Species or species habitat known to occur

Name	Threatened	Type of Presence
[84995]		within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
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	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 known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat may occur within area
Fish		
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied		Species or species

Name	Threatened	Type of Presence
Pipefish [66194]		habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		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 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
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 planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus 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

Name	Threatened	Type of Presence
		habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	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	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Congregation or aggregation 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 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	Congregation or aggregation known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat 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	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
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area

Name	Status	Type of Presence
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat 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
Ningaloo	Recreational Use Zone (IUCN IV)

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
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

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-21.6628495747 114.091904552,-21.6628500155 114.087353246,-21.6628503314 114.082801956,-21.6628505222 114.078250682,-21.6628505879 114.073699424,-21.6628505286 114.069148182,-21.6628503443 114.064596956,-21.6628500349 114.060045746,-21.6628496005 114.055494552,-21.6628490085 114.050705892,-21.6605671125 114.047149395,-21.658159521 114.043397229,-21.655751858 114.039645192,-21.6533441237 114.035893287,-21.650936318 114.032141512,-21.6485284409 114.028389868,-21.6461204925 114.024638354,-21.6437124729 114.020886971,-21.641304382 114.017135719,-21.6388962199 114.013384597,-21.6364879867 114.009633605,-21.6340796822 114.005882744,-21.6316713067 114.002132014,-21.6292628601 113.998381414,-21.6268543424 113.994630945,-21.6244457537 113.990880606,-21.6220370941 113.987130398,-21.6196283634 113.98338032,-21.6172195619 113.979630372,-21.6148106894 113.975880555,-21.6124017461 113.972130869,-21.6098184025 113.968524191,-21.606558495 113.965617905,-21.6027540648 113.96360618,-21.5986155199 113.962600178,-21.5943650423 113.962492005,-21.5901109578 113.962492676,-21.5858568714 113.96249333,-21.5816027832 113.962493967,-21.5773486931 113.962494588,-21.5730946011 113.962495192,-21.5688405072 113.962495779,-21.5645864115 113.96249635,-21.5603323139 113.962496903,-21.5560782144 113.962497441,-21.5518241131 113.962497961,-21.5475700099 113.962498465,-21.5433159049 113.962498952,-21.5390617979 113.962499422,-21.5348076892 113.962499876,-21.5305670852 113.962761859,-21.5264911993 113.964026396,-21.5228042491 113.966273109,-21.5195654618 113.969218653,-21.5163679215 113.972217357,-21.5131703108 113.975215927,-21.5099726297 113.978214363,-21.5067748782 113.981212666,-21.5035770563 113.984210836,-21.5003791641 113.987208871,-21.4986402464 113.988839029,-21.4924450888 113.988839859,-21.4881908697 113.988840409,-21.4839366487 113.988840942,-21.4796853032 113.988935308,-21.4755401759 113.989910209,-21.4717227481 113.991892109,-21.4684439938 113.994771375,-21.4658851105 113.998388828,-21.4641875195 114.002544536,-21.4634450603 114.007008851,-21.4636992082 114.01153501,-21.4649361323 114.015872493,-21.4670868149 114.01978157,-21.4700323858 114.023046196,-21.4736100506 114.025485905,-21.4776220751 114.026965774,-21.4818467309 114.027408529,-21.4861010831 114.027409128,-21.4903554334 114.02740971,-21.4946097819 114.027410275,-21.4988641284 114.027410825,-21.5031184731 114.027411358,-21.5073690421 114.027299822,-21.5115063726 114.02628748,-21.5153082226 114.024270674,-21.5186188839 114.021423194,-21.5218174325 114.018425402,-21.525015911 114.015427477,-21.5282143192 114.012429419,-21.5314126571 114.009431227,-21.5346109248 114.006432901,-21.5378091221 114.003434441,-21.5403188978 114.001081269,-21.5454888074 114.001082059,-21.5497430429 114.00108269,-21.5539972765 114.001083306,-21.5582515082 114.001083905,-21.5625057381 114.001084487,-21.5667599661 114.001085053,-21.5710141922 114.001085603,-21.5752684165 114.001086136,-21.5795226389 114.001086653,-21.5837768595 114.001087154,-21.5872117192 114.001087546,-21.5900840894 114.005559202,-21.5924925076 114.009308849,-21.5949008547 114.013058626,-21.5973091309 114.016808533,-21.5997173361 114.020558571,-21.6021254703 114.024308739,-21.6045335333 114.028059037,-21.6069415253 114.031809466,-21.6093494461 114.035560024,-21.6117572958 114.039310713,-21.6141650743 114.043061533,-21.6165727815 114.046812482,-21.6189804175 114.050563562,-21.6213879822 114.054314773,

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Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

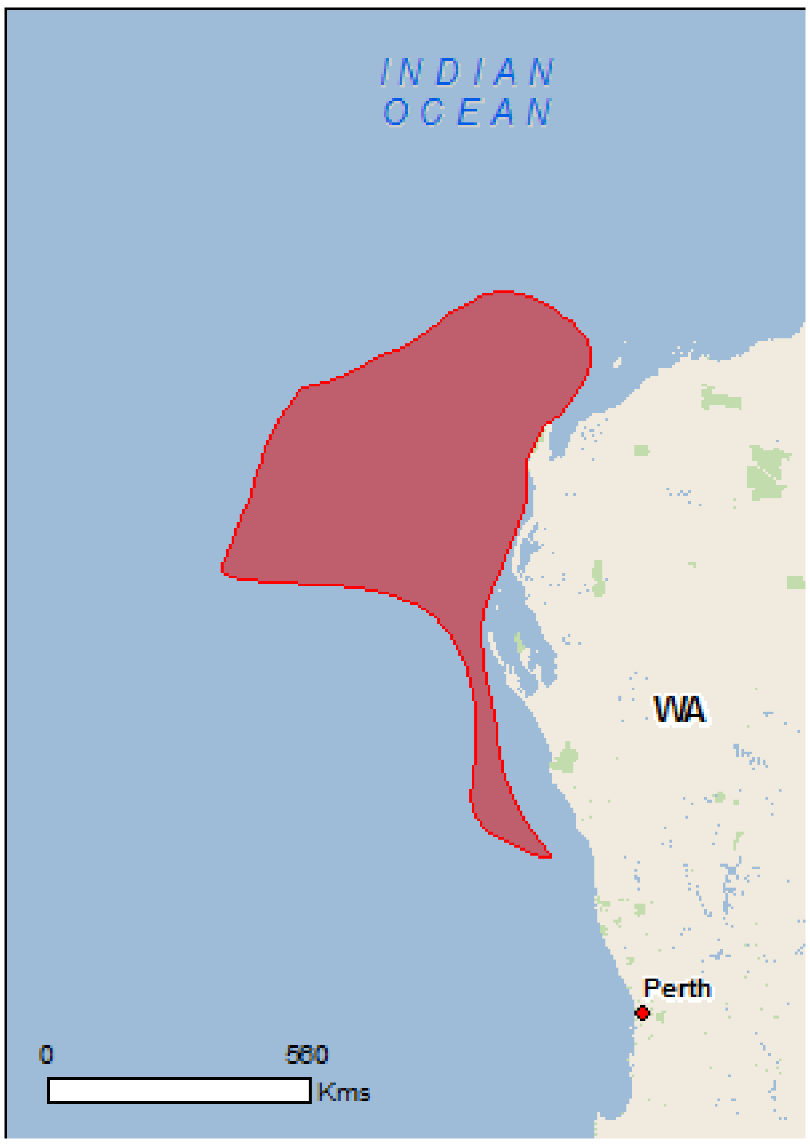
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

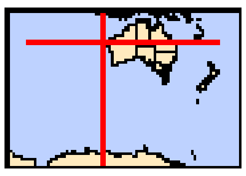
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 12/09/19 10:47:57



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	42
Listed Migratory Species:	61

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:	116
Whales and Other Cetaceans:	36
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	11

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:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	11

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	Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically 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 epomophora		
Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area

Name	Status	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely 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
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	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	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis 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		

Name	Threatened	Type of Presence
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may 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]		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 Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		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
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
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	Congregation or aggregation known to occur within area

Name	Threatened	Type of Presence
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within 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 likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth 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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely 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

Name	Threatened	Type of Presence
		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 veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely 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]		Foraging, feeding or related behaviour likely 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]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	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 australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
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
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Aipysurus pooleorum Shark Bay Seasnake [66061]		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 habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	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

Name	Status	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
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	Congregation or aggregation 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 layardii Strap-toothed Beaked Whale, Strap-toothed		Species or species

Name	Status	Type of Presence
Whale, Layard's Beaked Whale [25556]		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]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	National Park Zone (IUCN II)
Abrolhos	Special Purpose Zone (IUCN VI)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)

Name	Label
Gascoyne	National Park Zone (IUCN II)
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
Cape Range	WA
Jurabi Coastal Park	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 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		

Name	Status	Type of Presence
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

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
Wallaby Saddle	North-west
Ancient coastline at 90-120m depth	South-west
Commonwealth marine environment surrounding	South-west
Perth Canyon and adjacent shelf break, and other	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

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Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
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Australian Government

Department of the Environment and Energy

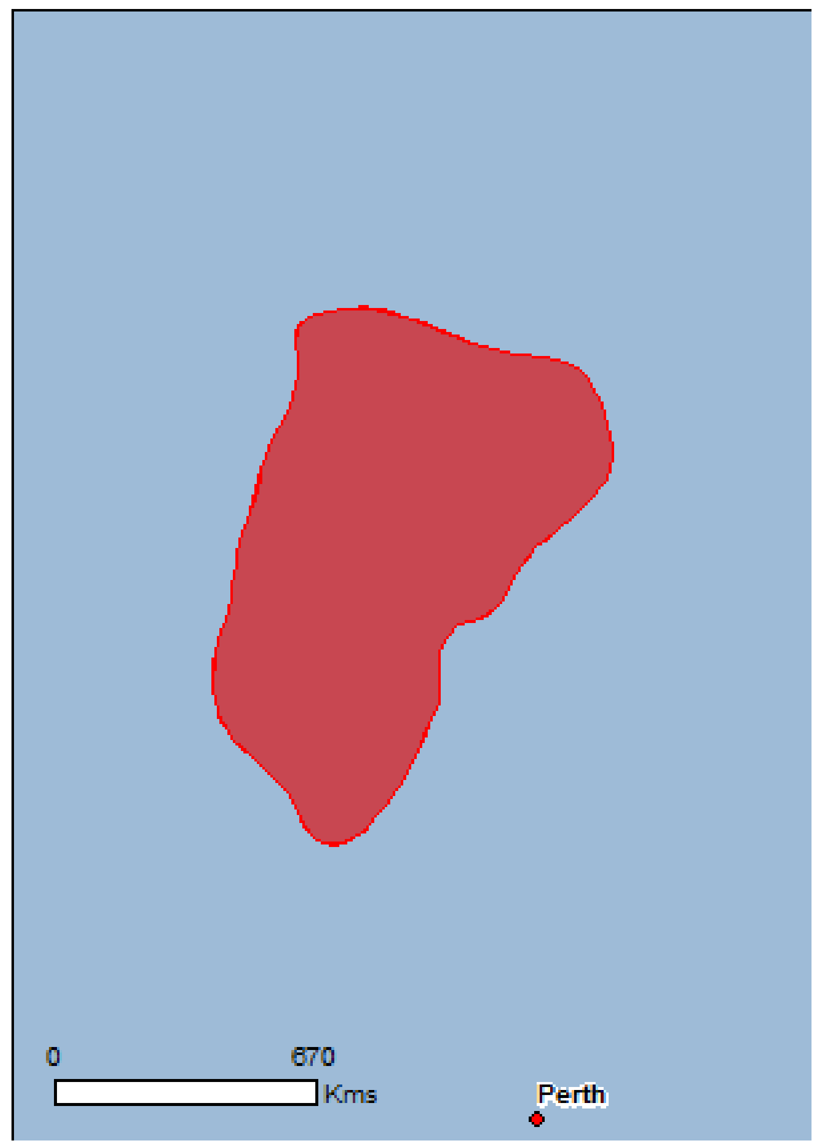
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

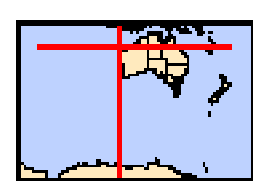
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 12/09/19 10:46:58



Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	2
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	48
Listed Migratory Species:	61

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:	2
Listed Marine Species:	113
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	10

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:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place
Historic		
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west
South-west

Listed Threatened 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
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
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, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	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
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
Lagorchestes hirsutus Central Australian subspecies		
Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Osphranter robustus isabellinus		
Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale lateralis lateralis		
Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis		
Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus zastictus		
Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		

Name	Status	Type of Presence
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Onychoprion anaethetus Bridled Tern [82845]		Breeding known 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 Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	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
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur

Name	Threatened	Type of Presence
		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	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place
Historic		
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely 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

Name	Threatened	Type of Presence
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna 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

Name	Threatened	Type of Presence
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		
Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable*	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		
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

Name	Threatened	Type of Presence
		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
[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

Name	Threatened	Type of Presence
		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
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		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 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

Name	Status	Type of Presence
		area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
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	Congregation or aggregation 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

Name	Status	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea 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)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Shark Bay	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Barrow Island	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Jurabi Coastal Park	WA
Montebello Islands	WA
Muiron Islands	WA
Serrurier Island	WA
Unnamed WA40828	WA
Unnamed WA41080	WA
Unnamed WA44665	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur

Name	Status	Type of Presence
		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 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
Wallaby Saddle	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

-25.7875661622 110.48394444,-25.5774728494 110.35940882,-25.3789443324 110.216962677,-25.1943660032 110.056807358,-25.0210161779 109.884643597,-24.8567158762 109.70378634,-24.6987808271 109.517326901,-24.5448503072 109.327533413,-24.3908249265 109.137826138,-24.2263782677 108.957267132,-24.0435520212 108.79565418,-23.834706214 108.669420729,-23.6099762317 108.574184282,-23.3750189436 108.507731026,-23.1343171475 108.466848654,-22.8904128904 108.457947027,-22.6478534424 108.485827929,-22.4076669502 108.530797665,-22.1690511248 108.583398793,-21.9366436918 108.658513716,-21.7062029372 108.739852173,-21.47269906 108.811668856,-21.2339621674 108.863626221,-20.9934885129 108.906852803,-20.7523375645 108.946414224,-20.511186616 108.985975646,-20.2705121937 109.028214554,-20.0316688797 109.079713722,-19.7964136586 109.145596473,-19.5683567836 109.233275863,-19.3424804872 109.326543139,-19.1116266074 109.406297393,-18.8751520659 109.467525047,-18.6372013532 109.52318782,-18.39998316 109.581771096,-18.1668096731 109.654533803,-17.9429283929 109.752103739,-17.726987871 109.866438978,-17.5134987372 109.985356074,-17.299738854 110.10375397,-17.078077874 110.206333624,-16.8485231719 110.289647358,-16.6125906339 110.352749215,-16.3719403481 110.394544136,-16.1280591487 110.406346973,-15.8842092839 110.392346945,-15.6406496703 110.372821938,-15.3972038964 110.383387067,-15.290024676 110.422541335,-15.1874880853 110.510304076,-15.0407851125 110.786433426,-14.9384963422 111.187386059,-14.902346514 111.428999597,-14.8805646378 111.672320778,-14.8746637875 111.916531899,-14.8897474886 112.160336786,-14.9287282277 112.401433515,-14.9891045526 112.638181845,-15.0619523949 112.87140979,-15.142922991 113.101961437,-15.2296069679 113.330432341,-15.318121019 113.558213264,-15.40663507 113.785994187,-15.4951491211 114.01377511,-15.5819651262 114.242186791,-15.6636210076 114.472515259,-15.7406471549 114.704385372,-15.8074602575 114.939407537,-15.8601733439 115.177964829,-15.8998692925 115.419022511,-15.9299007879 115.661536016,-15.9592955602 115.904136168,-15.9908438464 116.146456717,-16.0310167237 116.387474428,-16.0925589001 116.623833174,-16.1935437773 116.845737087,-16.3554338573 117.027764827,-16.5533354674 117.170426886,-16.767765908 117.287182618,-16.9912096584 117.385893912,-17.2202659577 117.470939188,-17.4538921694 117.542489735,-17.6914270645 117.599514523,-17.9327130004 117.636840714,-18.1765209524 117.644319928,-18.4165008056 117.604243861,-18.6396149385 117.506347411,-18.8397734404 117.366829948,-19.0214078073 117.203578069,-19.1911484362 117.027841878,-19.3522814679 116.844165462,-19.5075981749 116.655506705,-19.660511253 116.464885414,-19.813424331 116.274264123,-19.9663374091 116.083642832,-20.1247023847 115.897614627,-20.3019752506 115.72967619,-20.4965757564 115.582252951,-20.7038463217 115.452852706,-20.9167889857 115.332959805,-21.125823062 115.206518397,-21.3157238275 115.053091892,-21.4662341576 114.902279754,-21.5659182284 114.778612187,-21.6509579072 114.60973156,-21.7661238198 114.159537537,-21.8262440209 114.052586069,-21.9700878668 113.901232541,-22.2047358388 113.747118837,-22.3895426034 113.673175708,-22.5551530894 113.648429313,-22.8895111695 113.674822432,-23.1661986757 113.676982845,-23.3876757218 113.64192325,-23.7020599691 113.528065075,-23.926330215 113.431052452,-24.1463104749 113.324621388,-24.3662907347 113.218190325,-24.5829415382 113.105156797,

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Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX D: OIL SPILL PREPAREDNESS AND RESPONSE STRATEGY SELECTION AND EVALUATION

Oil Spill Preparedness & Response Mitigation Assessment for Nganhurra Cessation of Operations Environment Plan

Security & Emergency Management

Hydrocarbon Spill Preparedness Unit

September 2020

Revision: 1b

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

Woodside Energy Ltd (Woodside) has developed its oil spill preparedness and response position for the Nganhurra Cessation of 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	**Credible Scenario-01 Hydrocarbon release surface/subsea scenario** Subsea release of 14,456 m^3 over 77 days of Enfield crude. 38.4% residual component of 5,551 $m^{3.}$ *(Surface release 235 m^3 per day for 5 days and seabed release of 184 m^3 per day for 72 days of Enfield crude)*	Section 2.2
	Credible Scenario-03 Hydrocarbon release caused by accidental removal of the subsea xmas tree with an ongoing leak Subsea release of 4897 m^3 over 77 days of Enfield Crude. 38.4% residual component of 1880 m^3 (24 m^3 per day).	
	Credible Scenario-05 Hydrocarbon release caused by marine vessel separation Instantaneous release of 500 m^3 of marine diesel. 5% residual component of 25 m^3.	
	Credible Scenario-06 Hydrocarbon release caused by marine vessel collision Instantaneous release of 652 m^3 of marine diesel. 5% residual component of 32.6 m^3.	
Hydrocarbon Properties	**Enfield crude (API 22.5)** Enfield Crude (API 22.5) contains a high proportion (~38% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a high dynamic viscosity (46.0 cP). The pour point of the whole oil (< -36 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures and which would begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 3% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 16% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 43% should evaporate over several days (265 °C < BP < 380 °C). **Marine Diesel (API 37.2)** 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 <	Section 6 of the EP Appendix A of the First Strike Plan (FSP)

	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. 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.	
Modelling Resultsf	**Stochastic modelling – Credible Scenario-01 and Credible Scenario-03** 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 thus 25 simulations per quarter). **Stochastic modelling – Credible Scenario-05 and Credible Scenario-06** A total of 200 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 thus 50 simulations per quarter). For Credible Scenario-06, the modelling from a 652 m^3 surface release of marine diesel from Woodside's North-west Australia 4D Marine Seismic Survey (RPS, 2020) was available and utilised. The release location used for the spill modelling is located in the south west corner of Operational Area 2, approximately 200 m from the boundary of the Ningaloo World Heritage Area (WHA) and 2 km south west of the integrated artificial reef (IAR) location. This scenario was identified as representing the worst-case due to its proximity to the WHA and the coast, and as the modelling predicted shoreline contact. In addition, the modelled spill volume of 652 m^3 is greater than the worst-case credible release volume of 500 m^3 for this hydrocarbon spill risk assessment. Basing the impact assessment for a vessel collision scenario on this modelling is considered conservative and consequently, the EMBA for a 500 m^3 surface release of marine diesel within Operational Area 2 is likely be smaller than the EMBA described for this scenario in the Environment Plan.	Section 2.3
	Deterministic modelling Deterministic modelling was then undertaken for scenario Credible Scenario-01 and Credible Scenario-06 (Table 2-1) as the worst-case credible scenarios (WCCS) to establish the following for response planning purposes: • Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2) • Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2) • Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m^2) Full deterministic modelling was not undertaken for scenario Credible Scenario-05 but the available results have been included for response planning. Results as follows:	

	Credible Scenario-01 Hydrocarbon release caused by a well loss of containment during well	**Credible Scenario-03 Hydrocarbon release caused by accidental removal of the subsea xmas tree**	**Credible Scenario-05 Hydrocarbon release caused by marine vessel separation**	**Credible Scenario-06 Hydrocarbon release caused by marine vessel collision**

		intervention/ abandonment **Subsea release of 14,456 m^3 over 77 days of Enfield crude. 38.4% residual component of 5,551 m^3.**	**with an ongoing leak** **Subsea release of 4897 m^3 over 77 days of Enfield Crude. 38.4% residual component of 1880 m^3**	**Surface release of 500 m^3 of marine diesel. 5% residual component of 25 m^3.**	**Surface release of 652 m^3 of marine diesel. 5% residual component of 32.6 m^3**	
	Minimum time to shoreline contact (above 100 g/m^2)	21 days (Ningaloo Coast – Mangrove Bay), 0.882 m^3 **Model 5, Q1**	No contact	2.25 days (Ningaloo Coast North), 0.389 m^3 **Model 5, Q1**	0.9 days (22 hours) (Ningaloo Coast North WHA), 19 m^3 **Model 5, Q1**	
	Largest volume ashore at any single Response Priority Area (RPA) (above 100 g/m^2)	889.935 m^3 (day 46.5 – Ningaloo Coast (total) – includes Jurabi-Lighthouse Beaches, Turquoise Bay, Mangrove Bay and Yardie Creek) 410.273 m^3 (day 40.5 – Lighthouse-Jurabi) 133.987 m^3 (day 41 – Muiron Islands) **Model 1, Q2**	No contact	197.4 m^3 (day 3.75 - Ningaloo Coast North) **Model 5, Q1**	139 m^3 (day 2 - Ningaloo Coast North WHA) **Model 42, Q2**	
	Largest total shoreline accumulation (above 100 g/m^2) across all shorelines	514.441 m^3 (day 81.5 – Barrow and Lowendal Islands) **Model 13, Q4**	No contact	199.99 m^3 (day 3.75 - Ningaloo Coast North) **Model 5, Q1**	139 m^3 (day 2 - Ningaloo Coast North WHA) **Model 42, Q2**	
Net Environmental Benefit Assessment		Monitor and evaluate, source control via light well intervention well control package, source control relief well drilling, source control (vessel), subsea dispersant injection, surface dispersant spraying, containment and recovery, protection and deflection, shoreline clean-up, oiled wildlife response, are all identified as potentially having a net environmental benefit (dependent on the actual spill scenario) and carried forward for further assessment.				Section 4

ALARP evaluation of selected response techniques		The evaluation of the selected response techniques shows the proposed controls reduced the risk to an ALARP and acceptable level for the risk presented in Section 2, including the implementation of considered additional, alternative or improved control measures.	Section 6

1 INTRODUCTION

1.1 Overview

Woodside has developed its oil spill preparedness and response position for the Nganhurra Cessation of 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 Nganhurra Cessation of Operations EP
- Oil Pollution Emergency Arrangements (OPEA) (Australia)
- the Nganhurra Cessation of Operations Oil Pollution Emergency Plan (OPEP) including:
  - First Strike Plan (FSP)
  - relevant Operations Plans
  - relevant Tactical Response Plans (TRPs)
  - relevant Supporting Plans, and
  - Data Directory.

The purpose of this document is to demonstrate that the risks and impacts from an unplanned hydrocarbon release and the associated response operations are controlled ALARP and to an acceptable level.

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 Oil Pollution 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.

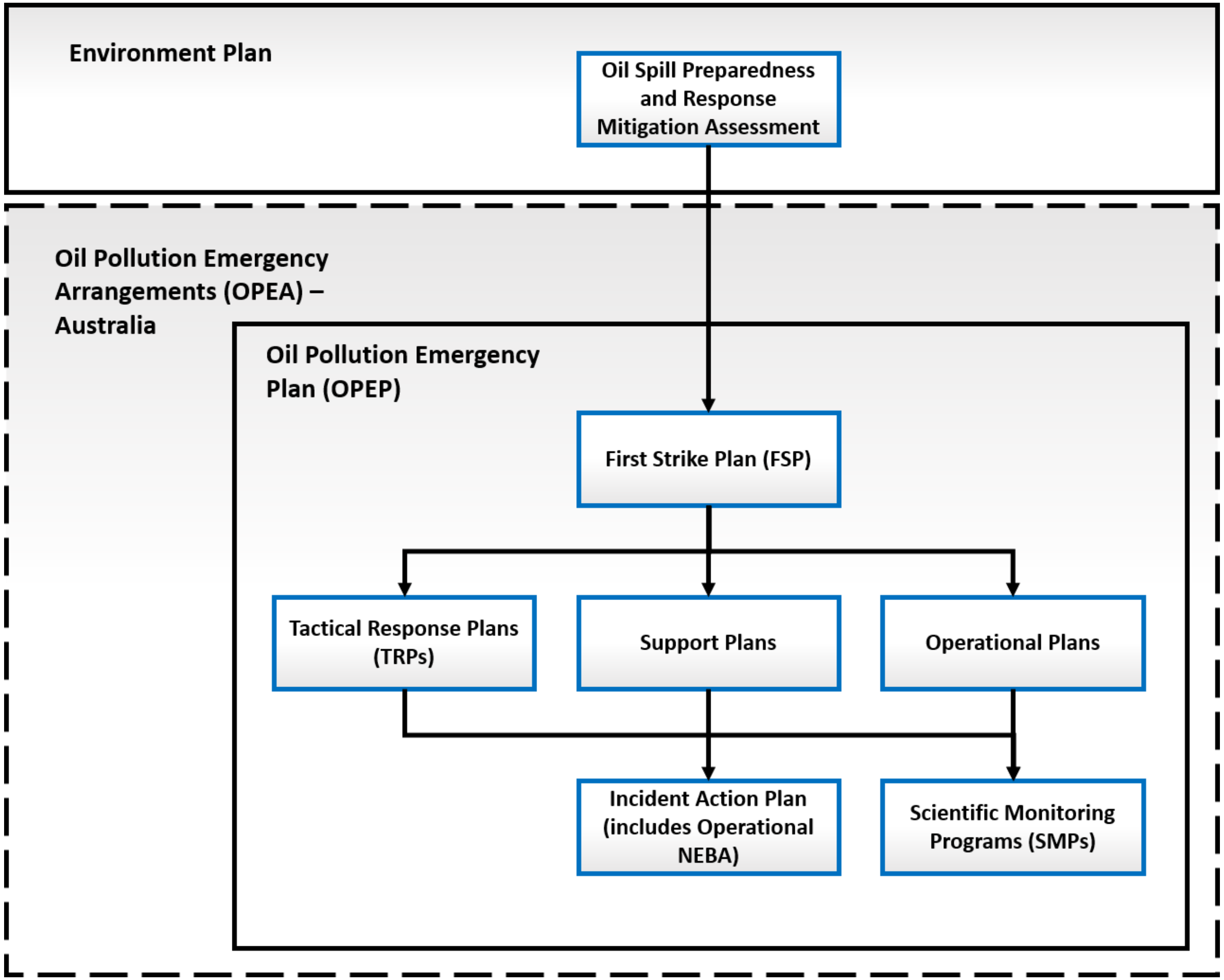

Figure 1-1: Woodside hydrocarbon spill document structure

Table 1-1: Hydrocarbon spill preparedness and response – document references

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
Nganhurra Cessation of Operations EP	Demonstrates that potential adverse impacts on the environment associated with the Nganhurra Cessation of 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 5 (Identification and evaluation of environmental risks and impacts, including credible spill scenarios) EP Section 6 (Implementation strategy – including emergency preparedness and response) EP Section 6 (Reporting and compliance) EP Section 6 (Performance outcomes, standards and measurement criteria)	
Oil Pollution Emergency Arrangements (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	
Oil Spill Preparedness and Response Mitigation Assessment for the Nganhurra Cessation of 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.	
Nganhurra Cessation of 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.	Site-based IMT for initial response, activation and notification.	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.	

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
	Oil Pollution First Strike Plans are intended to be the first document used to provide immediate guidance to the responding IMT.	CICC for initial response, activation and notification. CICC: Control function in an ongoing spill response for activity-specific response information.	Details and forms for use in immediate response. Activation process for oil spill trajectory modelling, aerial surveillance and oil spill tracking buoy details.	
Operational Plans	Lists the actions required to activate, mobilise and deploy personnel and resources to commence response operations. Includes details on access to equipment and personnel (available immediately) and steps to mobilise additional resources depending on the nature and scale of a release. Relevant operational plans will be initially selected based on the Oil Pollution First Strike Plan; additional operational plans will be activated depending on the nature and scale of the release.	CICC: Operations and Logistics functions for first strike activities. CICC: Planning Function to help inform the IAP on resources available.	Locations from where resources may be mobilised. How resources will be mobilised. Details of where resources may be mobilised to and what facilities are required once the resources arrive. Details on how to implement resources to undertake a response.	Operational Monitoring Plan Source Control Emergency Response Planning Guideline Subsea Dispersants Surface Dispersants Containment and Recovery Protection and Deflection Shoreline Clean-up Oiled Wildlife Scientific Monitoring
Tactical Response Plans	Provides options for response techniques in selected 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.	Mangrove Bay Turquoise Bay Yardie Creek Muiron Islands Jurabi to Lighthouse Beaches Exmouth Shark Bay Area 1: Carnarvon to Wooramel Shark Bay Area 2: Wooramel to Petite Point

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
				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 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 Shark Bay (Oiled Wildlife Response)
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.	Technique 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

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
				IT (First Strike Response) IT (Extended Response) Communications (First Strike Response) Communications (Extended Response) Stakeholder Engagement Accommodation and Catering Waste Management Guidance for Oil Spill Claims Management (Land based) Security Support Plan Hydrocarbon Spill Responder Health Monitoring Guideline

2 RESPONSE PLANNING PROCESS

This document details Woodside's process for identifying potential response options for the hydrocarbon release scenarios, identified in the EP. Figure 2-1 outlines the interaction between Woodside's response, planning/preparedness and selection process.

This structure has been used because it shows how the planning and preparedness activities inform a response and provides indicative guidance on what activities would be undertaken, in sequential order, if a real event were to occur. The process also evaluates alternative, additional and/or improved control measures specific to the PAP.

The Nganhurra Cessation of 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.

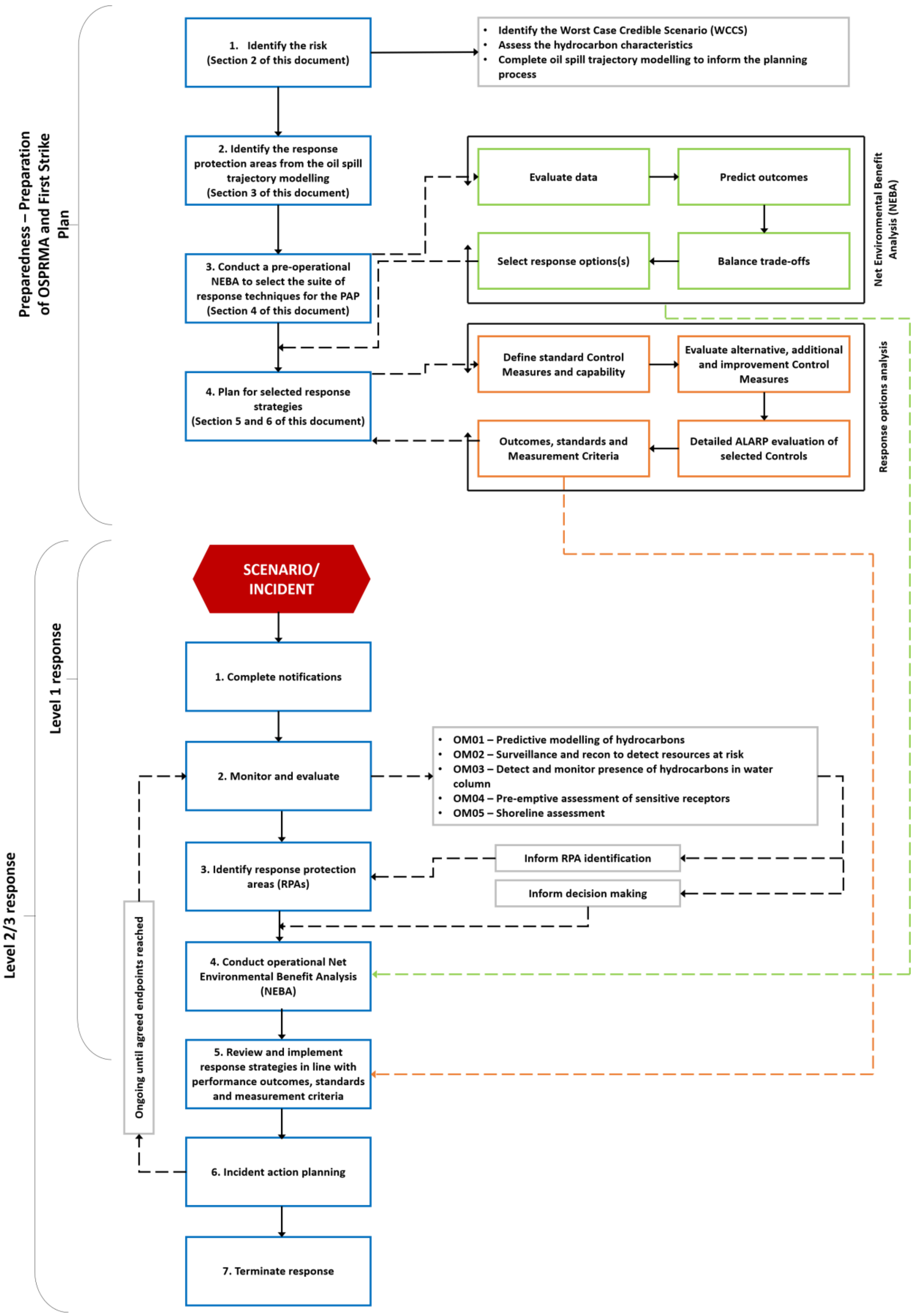

Figure 2-1: Response planning and selection process

2.1 Response planning process outline

This document is expanded below to provide additional context on the key steps in determining capability, evaluating ALARP and hydrocarbon spill response requirements.

Section 1. INTRODUCTION

Section 2. RESPONSE PLANNING PROCESS

- identification of worst-case credible scenario(s) (WCCS)
- spill modelling for WCCS

Section 3. IDENTIFY RESPONSE PROTECTION AREAS (RPAs)

- areas predicted to be contacted at concentration >100g/m^2.

Section 4. NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

- pre-operational NEBA (during planning/ALARP evaluation): this must be reviewed during the initial response to an incident to ensure its accuracy
- selected response techniques prioritised and carried forward for ALARP assessment

Section 5. HYDROCARBON SPILL ALARP PROCESS

- determines the response need based on predicted consequence parameters.
- details the environmental performance of the selected response options based on the need.
- sets the environmental performance outcomes, environmental performance standards and measurement criteria.

Section 6. ALARP EVALUATION

- evaluates alternative, additional, and improved options for each response technique to demonstrate the risk has been reduced to ALARP.
- provides a detailed ALARP assessment of selected control measure options against:
  - predicted cost associated with implementing the option
  - predicted change to environmental benefit
  - predicted effectiveness / feasibility of the control measure

Section 7. ENVIRONMENTAL RISK ASSESSMENT OF SELECTED RESPONSE TECHNIQUES

- evaluation of impacts and risks from implementing selected response options

Section 8. ALARP CONCLUSION

Section 9. ACCEPTABILITY CONCLUSION

2.1.1 Response planning assumptions – timing, resourcing and effectiveness

Figure 2-2 illustrates the initial steps of a response to an oil spill event and, where available, the indicative timing. For the latter stages, the timing will be specific to the selective response option.

IMT Call-out/ Notification	Contract Activation	Response Option Mobilisation	Response Option Deployment	Response Option Effectiveness
This is the time taken from call-out to mobilise the IMT to the designated Incident Control Centre	This is the time taken once the IMT has been mobilised to activate specific contracts for resources (SFRT, FWADC, AMOSC, AMSA, OSRL, etc)	This is the time taken to mobilise resources from home location to laydown/staging area (expected to be airport or sea port) close to response area	This is the time taken to deploy resources from laydown/staging area (expected to be airport or sea port) to response area/field	This relates to the performance of equipment/response option as well as required personnel resourcing (Specialists/Supervisors + support personnel)
Approx 2-4 hours	Approx 2-4 hours	Response Technique specific	Field/Location specific	Response Strategy specific

Figure 2-2: Response planning assumptions – timing, resourcing and effectiveness

2.2 Environment plan risk assessment (credible spill scenarios)

Potential hydrocarbon release scenarios from the PAP have been identified during the risk assessment process (Section 6 of the EP). Further descriptions of risk, impacts and mitigation measures (which are not related to hydrocarbon preparedness and response) are provided in Section 6 of the EP. Four 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.

Table 2-1 presents the credible scenarios for the PAP. 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.

The Nganhurra Cessation of Operations loss of well containment scenario (Credible Scenario-01) has been deterministically modelled and considered to determine the WCCS for response planning purposes. Deterministic modelling was also available for the vessel collision scenario (Credible Scenario-06) and has been considered in the response planning due to the shorter impact times.

Table 2-1: Petroleum activities program credible spill scenarios

MEE No.[1]	Scenario selected for planning purposes	Scenario description	Maximum credible volume released (liquid m^3)[1]	Incident Level	Hydrocarbon (HC) type	Residual proportion	Residual volume (liquid m^3)
Credible Scenario-01	Yes	Uncontrolled release of Enfield crude caused by loss of well containment during well intervention/ abandonment. Surface: 235.40 m^3 per day for 5 days Seabed: 184.43 m^3 per day for 72 days	14,456 m^3	Level 3 (WCCS)	Enfield Crude	38.4%	72 m^3 a day (averaged over entire duration) 5,551 m^3 total
Credible Scenario-03	No	Hydrocarbon release caused by accidental removal of the subsea xmas tree with an ongoing leak via the annulus due to a passing gas lift valve in the production tubing during well intervention/ abandonment. Uncontrolled subsea release of 4897 m^3 over 77 days.	4897 m^3	Level 2	Enfield crude	38.4%	24 m^3 a day 1880 m^3 total
Credible Scenario-05	Yes	Hydrocarbon release caused by marine vessel separation. Instantaneous release of 500 m^3 of marine diesel within the Operational Area.	500 m^3	Level 2	Marine diesel	5%	25 m^3
Credible Scenario-06	Yes	Hydrocarbon release caused by marine vessel collision. Instantaneous release of 652 m^3 of marine diesel within Operational Area 2.	652 m^3	Level 2	Marine diesel	5%	32.6 m^3

[1] A full description of Credible Scenarios used in this document is included in EP Section 6.8.

2.2.1 Hydrocarbon characteristics

Hydrocarbon characteristics, including modelled weathering data and ecotoxicity, are included in Section 6 of the EP.

Enfield Crude

Enfield Crude (API 22.5°) contains a high proportion (~38% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a high dynamic viscosity (46.0 cP). The pour point of the whole oil (< -36 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures and which would begin to evaporate at different rates on exposure to the atmosphere.

Evaporation rates will increase with temperature, but in general about 3% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 16% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 43% should evaporate over several days (265 °C < BP < 380 °C).

Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. No information has been made available to allow judgement as to whether or not the mixture will eventually solidify or sink as it weathers.

The whole oil has 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 13.5% by mass of the whole oil, mostly in the C16- C20 range of hydrocarbons. These compounds would evaporate slowly, leaving the potential for dissolution of a proportion of them into the water.

Marine Diesel

Marine Diesel is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group two 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. It is predicted that 25 m^3 of product would remain after weathering from the representative marine diesel scenario.

2.3 Hydrocarbon spill modelling

Oil spill trajectory modelling (OSTM) tools are used for environmental impact assessment and during response planning to understand spatial scale and timeframes for response operations. Woodside recognises that there is a degree of uncertainty related to the use of modelling data and has subsequently utilised conservative approaches to volumes, weathering, spatial areas, timing and response effectiveness to scale capability to need.

The Oil Spill Model and Response System (OILMAP) and Integrated Oil Spill Impact Model System (SIMAP) models are both used for stochastic and deterministic trajectory modelling. They have been developed over three decades of planning, exercises, actual responses, several peer reviews, and validation studies. OILMAP was originally derived from the United States Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Type A model (French et al. 1996), for assessing marine transport, biological impact and economic damage that was also used under the United States Oil Pollution Act 1990 Natural Resource Damage Assessment (NRDA) regulations. Notable spills where the model has been used and validated against actual field observations include, Exxon Valdez (French McCay 2004), North Cape Oil Spill (French McCay 2003), along with an assessment of 20 other spills (French McCay and Rowe, 2004). In addition, test spills designed to verify fate, weathering and movement algorithms have been conducted regularly and in a range of climate conditions (French and Rines 1997; French et al. 1997; Payne et al. 2007; French McCay et al. 2007).

Further to this, the algorithms have been updated using the latest findings from the Macondo/Deepwater Horizon well blowout in the Gulf of Mexico and validated according to the Deepwater Horizon (DWH) oil spill in support of the NRDA (Spaulding et al. 2015; French McCay et al. 2015, 2016).

Finally, the OILMAP and SIMAP models have been used extensively in Australia to prosecute pollution offences, predict discharge locations and likely spill volumes based on weathering and surveillance observations, and has been used as expert witness evidence in Australian court proceedings, aiding the prosecution to determine spill quantum estimates.

2.3.1 **Stochastic modelling**

Stochastic modelling has been completed for the scenarios outlined in Table 2-1. A quantitative, stochastic assessment has been undertaken for credible spill scenarios to help assess the environmental consequences of a hydrocarbon spill.

A total of 100 replicate simulations were completed for Credible Scenario-01 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). 200 replicate simulations were completed for Credible Scenario-05 and Credible Scenarion-06. 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 – 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 Environment that May Be Affected (EMBA) and is discussed further in Section 6 of the EP. As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is presented for each fate within the EP.

A conservative approach – adopting accepted contact thresholds for impacts on the marine environment – is used to define the EMBA. These hydrocarbon thresholds are presented in Table 2-2 below and described in Section 6 of the EP.

Table 2-2: Summary of thresholds applied to the stochastic hydrocarbon spill modelling to determine EMBA and environmental impacts

<table>
<tr><th>Floating Oil Concentration (g/m²)</th><th>Shoreline Oil Concentration (g/m²)</th><th>Entrained Oil Concentration (ppb)</th><th>Dissolved Aromatic Hydrocarbon Concentration (ppb)</th></tr>
<tr><td>1</td><td>10</td><td>10</td><td>10</td></tr>
<tr><td>10</td><td>100</td><td>100</td><td>50</td></tr>
<tr><td rowspan="3">50</td><td rowspan="3">1,000</td><td>340</td><td>340</td></tr>
<tr><td rowspan="2">500</td><td>400</td></tr>
<tr><td>500</td></tr>
</table>

2.3.2 Deterministic modelling

Woodside uses deterministic modelling results to evaluate risks and impacts and response capability requirements. These results are provided in both shapefile and data table format with each row of the data table representing a 1 km^2 cell. This cell size has been used as it represents the approximate area that a single containment and recovery operation or surface dispersant operation (single sortie or vessel spraying) can effectively treat in one ten (10) hour day. Smaller cell sizes have been considered but would not change the response need as the potential distance between cells would not allow multiple cells to be treated per day by response operations. Additionally, a 1 km^2 cell is expected to allow averaging of threshold concentrations and mass across the spatial extent to represent a conservative approach (patches of oil and windrows) to response planning that simulates operational monitoring feedback in a real event.

A sample of these deterministic results from the Nganhurra Cessation of Operations topsides release 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
-21.502518	114.000366	6	0.107764	381.362427	88.131	0.088131
-21.515158	113.996559	6	0.107892	381.362427	88.131	0.088131
-21.506552	113.990494	6	0.107861	381.362427	88.131	0.088131
-21.505835	113.992508	6	0.154358	381.362427	88.131	0.088131
-21.498177	113.992973	6	0.147649	381.362427	88.131	0.088131
-21.512182	113.992432	6	0.44108	381.362427	88.131	0.088131
-21.50848	113.991943	6	1.173753	381.362427	88.131	0.088131
-21.508913	113.989983	6	1.165524	381.362976	88.131	0.088131
-21.505316	113.994568	6	0.95638	381.362427	88.131	0.088131

The deterministic modelling data provides an indication of the response need by displaying the potential surface area and volume that may be treated or recovered by response operations. Existing capability is reviewed to approximate the surface area and volumes that can be treated or removed and a range of alternate, improved and additional options to reduce risks and impacts to ALARP are considered.

Woodside recognises that no single response technique will treat all available subsea or surface oil and that a combination of response techniques will be required for the identified scenario. Even with the significant resources available to Woodside through existing capability and third-party resources, the primary offshore response techniques of surface dispersant application and containment and recovery will only treat or recover a minor proportion (<30%) of the available surface hydrocarbons based on previous response experience.

Woodside is committed to a realistic, scalable response capability that is commensurate to the level of risk and able to be practically implemented and feasibly sustained.

2.3.2.1 Response planning thresholds for surface and shoreline hydrocarbon exposure

Thresholds to determine the EMBA are used to predict and assess environmental impacts and inform the 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.

2.3.2.2 Surface hydrocarbon concentrations

Table 2-4: Hydrocarbon thresholds for response planning

Surface hydrocarbon concentration (g/m^2)	**Description**	**Bonn Agreement Oil Appearance Code**	**Mass per area (g/m^2)**
>10	Predicted minimum threshold for commencing operational monitoring[2]	Code 3 – Dull metallic colours	5 to 50
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [3]	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 concentration (g/m^2)	**Description**	**National Plan Guidance on Oil Contaminated Foreshores**	**Mass per area (g/m^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 - 1000

[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. DoT or AMSA.

[3] At 50 g/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.

The surface thickness of oil at which dispersants are typically effective is approximately 100 g/m^2. However, substantial variations occur in the thickness of the oil within the slick, and most fresh crude oils spread within a few hours, so that overall the average thickness is 0.1 mm (or approx. 100 g/m^2) (International Tanker Owners Pollution Federation [ITOPF] 2011). Additionally, the recommended rate of application for surface dispersant is typically 1-part dispersant to 20 or 25 parts of spilled oil. These figures assume a 0.1 mm slick thickness, averaged over the thickest part of the spill, to calculate a litres/hectare application rate from vessels and aircraft. In practice, this can be difficult to achieve as it is not possible to accurately assess the thickness of the floating oil.

Some degree of localised over-dosage and under-dosage is inevitable in dispersant response. An average oil layer thickness of 0.1 mm is often assumed, although the actual thickness can vary over a wide range (from less than 0.0001 mm to more than 1 mm) over short distances (International Petroleum Industry Environment Conservation Association [IPIECA] 2015).

Guidance from AMSA (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 is found in the document: *Characteristics of Response Techniques: 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 50 g/m^2 was chosen as an average / equilibrium thickness (50 g/m^2 is an average of 50% coverage of 0.1 mm Bonn Agreement Code 4 – discontinuous true oil colour, or 25% coverage of 0.2 mm Bonn Agreement Code 5 – continuous true oil colour which would represent small patches of thick oil or wind-rows.

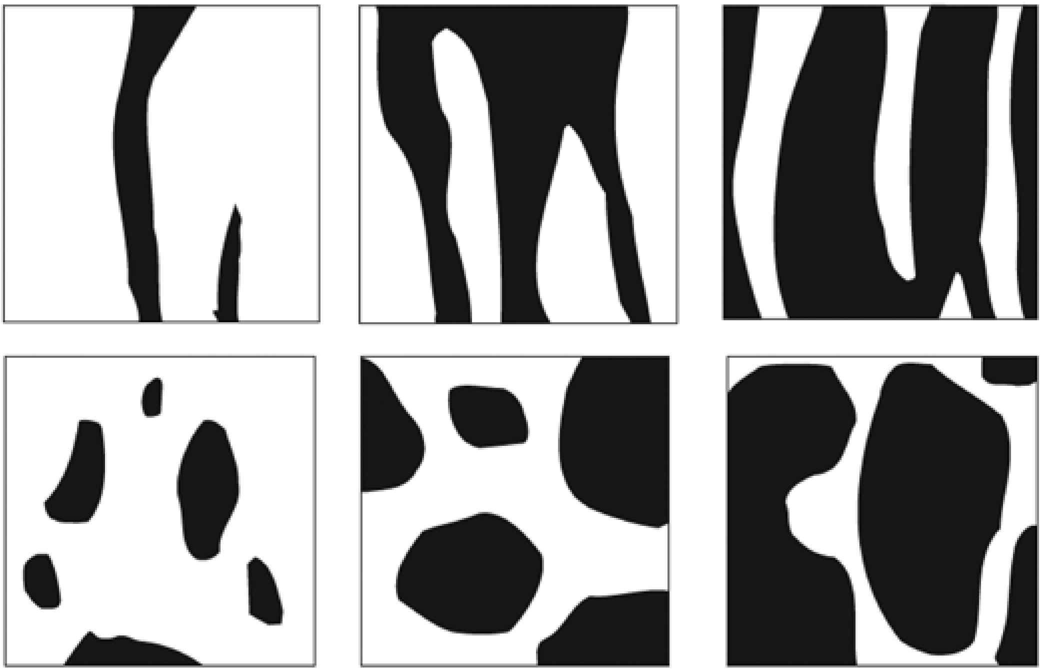

Figure 2-3: Proportion of total area coverage (AMSA, 2014)

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.

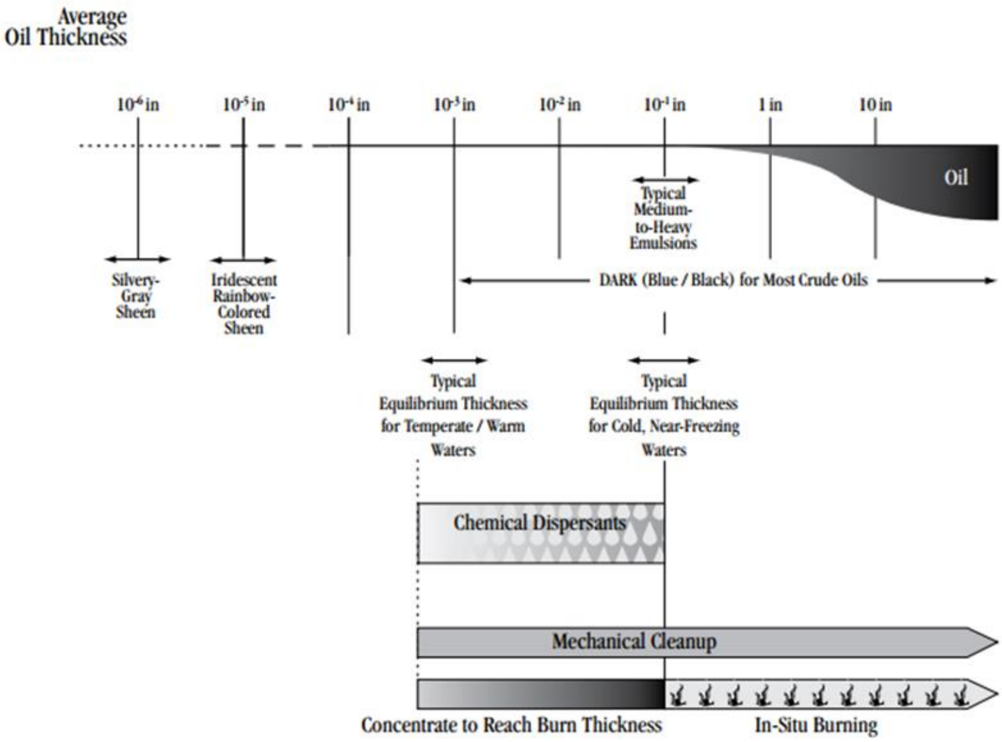

Figure 2-4: Oil thickness versus potential response options (from Allen & Dale 1996)

Wind and wave influence on the feasibility of response operations are also considered below:

- 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.

2.3.2.3 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	500-5000
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.s (1,000 – 2,000 cSt) and then declining to a low level with an oil viscosity of 15,000 mPa.s (15,000 cSt). It was considered that some generally applicable viscosity limit, such as 2,000 or 5,000 mPa.s (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.s (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

Details of the scenario and modelling inputs are included along with deterministic results in Table 2-6.

The selected deterministic runs used to represent the WCCS are based on response thresholds:

- Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2).
- Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor.
- Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors.

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. Full deterministic modelling was not undertaken for scenario Credible Scenario-05 but the available information has been included for response planning.

Table 2-6: Worst case credible scenario modelling results

Response parameter	Modelled result			
	Credible Scenario-01 **Hydrocarbon release caused by a well loss of containment during well intervention/ abandonment**	**Credible Scenario-03** **Hydrocarbon release caused by accidental removal of the subsea xmas tree with an ongoing leak**	**Credible Scenario-05** **Hydrocarbon release caused by marine vessel separation**	**Credible Scenario-06** **Hydrocarbon release caused by vessel collision**
Maximum continuous liquid hydrocarbon release rate and duration	Subsea release of 14,456 m^3 over 77 days of Enfield Crude. *(Surface release 235 m^3 per day for 5 days and seabed release of 184 m^3 per day for 72 days of Enfield crude)*	Uncontrolled subsea release of 4897 m^3 over 77 days of Enfield Crude *(Subsea release of 64 m^3 per day for 77 day of Enfield Crude).*	Instantaneous surface release of 500 m^3 marine diesel.	Instantaneous surface release of 652 m^3 marine diesel.
Maximum residual surface hydrocarbon after weathering	38.4% residual component – 5,551 m^3 Enfield Crude	38.4% residual component – 1880 m^3 Enfield Crude	5% residual component – 25 m^3 marine diesel	5% residual component – 32.6 m^3 marine diesel
	Deterministic modelling results			
Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	21 days at Ningaloo Coast – Mangrove Bay (0.882 m^3**)** Model 5, Q1	No contact	2.25 days at Ningaloo Coast North (0.389 m^3) Model 5, Q1	0.9 days (22 hours) (Ningaloo Coast North WHA), 19 m^3 **Model 5, Q1**
Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2)	6.8 days at Gascoyne Marine Park	No contact at threshold	8 hours at Gascoyne Marine Park	0.5 days (12 hours) at Ningaloo Coast North **Model 11, Q1**
Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor	889.935 m^3 (day 46.5 – Ningaloo Coast (total) – includes Jurabi-Lighthouse	No contact	197.4 m^3 (day 3.75 - Ningaloo Coast North) Model 5, Q1	139 m^3 (day 2 - Ningaloo Coast North WHA) **Model 42, Q2**

	Beaches, Turquoise Bay, Mangrove Bay and Yardie Creek) 410.27 m^3 (day 40.5 – Lighthouse-Jurabi) 133.98 m^3 (day 41.00 – Muiron Islands) Model 1, Q2			
Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m^2 accumulation concentration)	514.4 m^3 (day 81.5 – Barrow and Lowendal Islands) Model 13, Q4	No contact	199.99 m^3 (day 3.75 - Ningaloo Coast North) Model 5, Q1	139 m^3 (day 2 - Ningaloo Coast North WHA) **Model 42, Q2**
Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb)	15 hours at Gascoyne Marine Park	Entrained hydrocarbons at or above 500 ppb are predicted to occur in the immediate vicinity of the leak location only.	10 hours at Gascoyne Marine Park	1 hour at Ningaloo Coast North WHA **Model 12, Q4**

Analysis of the deterministic modelling results predicts the following;

- Surface oil concentrations of Enfield Crude for both Credible Scenario-01 and Credible Scenario-03 will not meet the 50 g/m^2 minimum concentration threshold required for surface dispersant application or containment and recovery operations to be effective. As a conservative approach, Woodside has included these as potential response techniques for Credible Scenario-01 as the WCCS in the instance that operational monitoring observes sufficient surface oil concentrations for them to be deployed. Dispersant application and containment and recovery are not appropriate for use on spills of marine diesel.
- If dispersant and containment and recovery are deemed appropriate during a spill event for Credible Scenario-01, the deterministic modelling predicts that the surface release (0-5 days) is within the operating limits of FWADC, C-130, 727, vessel dispersant application and containment and recovery operations up to approx. Day 15.
- From Day 45 (Credible Scenario-01), shoreline contact (above 100g/m^2) accumulations have peaked and additional shoreline hydrocarbon contact is significantly reduced.

3 IDENTIFY RESPONSE PROTECTION AREAS

In a response, operational monitoring programs – including trajectory modelling and vessel/aerial observations – would be used to predict RPAs that may be impacted. For the purposes of planning and appropriately scaling a response, modelling has been used to identify RPAs as outlined below in Figure 3-1.

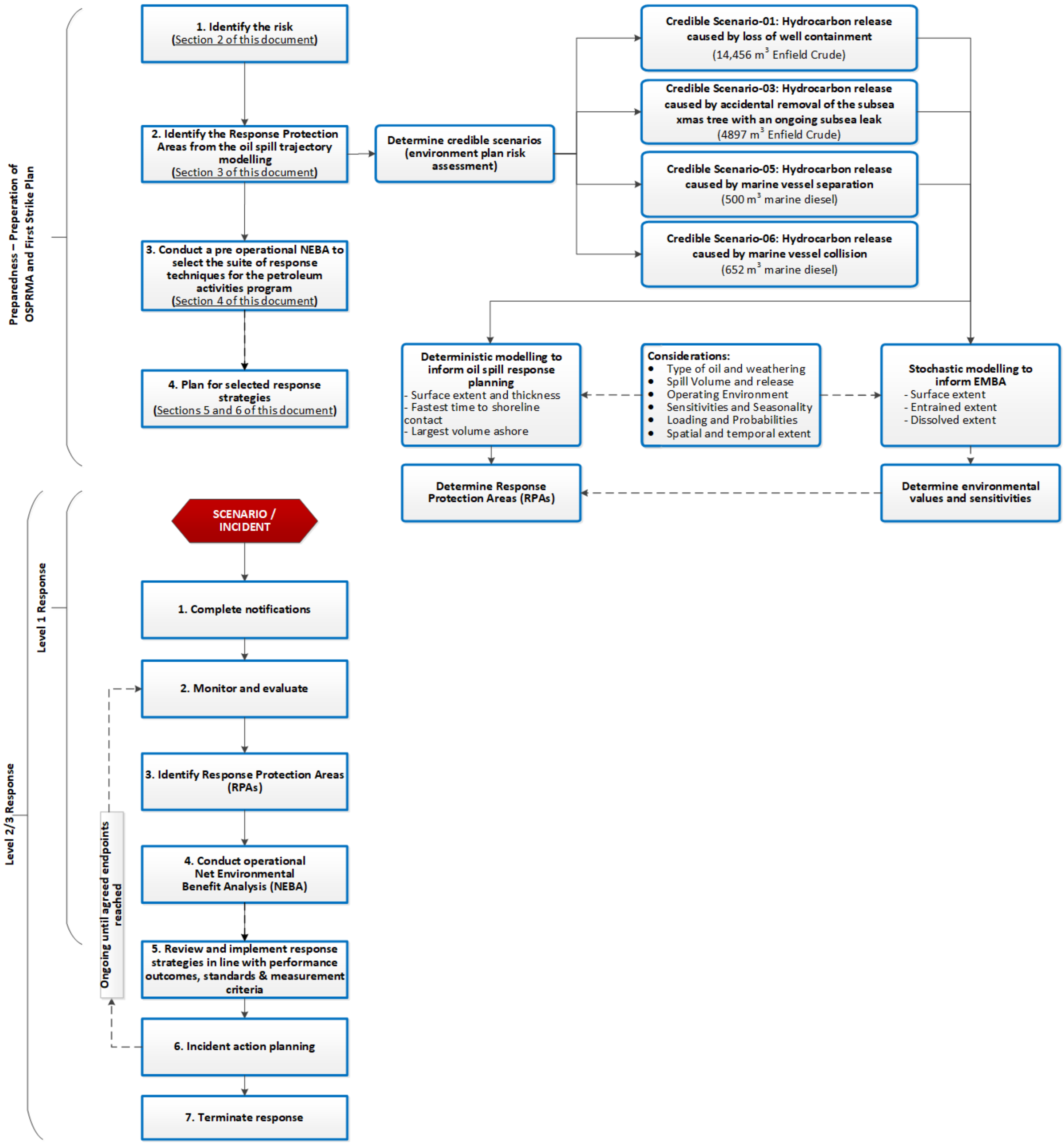

Figure 3-1: Identify response protection areas (RPAs) flowchart

3.1 Identified sensitive receptor locations

Section 4 of the EP includes the list of sensitive receptor locations that have been identified by stochastic modelling as meeting the requirements outlined below:

- receptors with the potential to incur surface, entrained or shoreline accumulation contact above environmental impact thresholds
- receptors within the EMBA which meet the following
  - a number of priority protection criteria/categories
  - International Union for Conservation of Nature (IUCN) marine protected area categories
  - high conservation value habitat and species
  - important socio-economic/heritage value.

3.2 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[4]) 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 in 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. Full deterministic modelling was not undertaken for scenario Credible Scenario-05 but the available information has been included for response planning.

[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/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

Table 3-1: Response protection areas (RPAs) from deterministic modelling (Credible Scenario-01, Credible Scenario-03 and Credible Scenario-06) and stochastic modelling (Credible Scenario-05)

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
Yardie Creek	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	45.75 days (6.00 m^3)	10.02 m^3 (day 53.75)	No contact	No contact	N/A	N/A	No contact	No contact
Turquoise Bay			44.5 days (8.317 m^3)	8.57 m^3 (day 87.5)	No contact	No contact	N/A	N/A	No contact	No contact
Mangrove Bay			21.0 days (0.882 m^3)	12.6 m^3 (day 52.25)	No contact	No contact	N/A	N/A	No contact	No contact
Jurabi-Lighthouse Beaches			40.5 days (410.27m^3)	410.27 m^3 (day 40.5)	No contact	No contact	N/A	N/A	No contact	No contact
Ningaloo Coast North and WHA	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	N/A	N/A	No contact	No contact	2.25 days (0.389 m^3)	197.4 m^3 (3.75 days)	22 hours (0.9 days) (19 m^3)	139 m^3 (day 2)
Ningaloo Coast Middle	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	N/A	N/A	No contact	No contact	3.5 days (0.08 m^3)	2.58 m^3 (4.25 days)	No contact at threshold	No contact at threshold
Shark Bay	State Marine Park Australian Marine Park	IUCN VI – Multiple Use Zone	58.5 days (215.22m^3)	215.22 m^3 (day 58.5)	No contact	No contact	No contact	No contact	No contact	No contact

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m²) in days	Maximum shoreline accumulation (>100g/m²) in m³	Minimum time to shoreline contact (>100g/m²) in days	Minimum time to shoreline contact (>100g/m²) in days	Maximum shoreline accumulation (>100g/m²) in m³	Maximum shoreline accumulation (>100g/m²) in m³	Minimum time to shoreline contact (>100g/m²) in days	Maximum shoreline accumulation (>100g/m²) in m³
	World Heritage Area									
Montebello Islands	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN – II and IV Recreational Use Zone IUCN II – Marine National Park Zone	60.0 days (4.46 m³)	33.14 m³ (day 81.25)	No contact	No contact	No contact	No contact	No contact	No contact
Barrow Island	Barrow Island Marine Park Barrow Island Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN IV – Recreational Use Zone	54.0 days (6.855 m³)	514.44 m³ (day 81.5)	No contact	No contact	No contact	No contact	No contact	No contact
Abrolhos Islands	Abrolhos Islands Australian Marine Park	IUCN II – Marine National Park Zone	61.5 days (4.91 m³)	4.91 m³ (day 61.5)	No contact	No contact	No contact	No contact	No contact	No contact

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m²) in days	Maximum shoreline accumulation (>100g/m²) in m³	Minimum time to shoreline contact (>100g/m²) in days	Minimum time to shoreline contact (>100g/m²) in days	Maximum shoreline accumulation (>100g/m²) in m³	Maximum shoreline accumulation (>100g/m²) in m³	Minimum time to shoreline contact (>100g/m²) in days	Maximum shoreline accumulation (>100g/m²) in m³
		IUCN VI – Multiple Use Zone IUCN IV – Recreational Use Zone								
Muiron Islands	Murion Islands Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	41.0 days (133.98m³)	133.98 m³ (day 41.00)	No contact	No contact	4.5 days (0.04 m³)	37.98 m³ (6 days)	No contact	No contact
Southern Islands Group	State Nature Reserve	IUCN VI - Multiple Use Zone	40.25 days (0.88 m³)	134.13 m³ (day 90.25)	No contact	No contact	No contact	No contact	No contact	No contact

4 NET ENVIRONMENTAL BENEFIT ANALYSIS

A Net Environmental Benefit Analysis (NEBA) is a structured process to consider which response techniques are likely to provide the greatest net environmental benefit.

The NEBA process typically involves four key steps outlined in Figure 4-1: evaluate data, predict outcomes, balance trade-offs, and select response options. These steps are followed in the planning/preparedness process and would also be followed in a response.

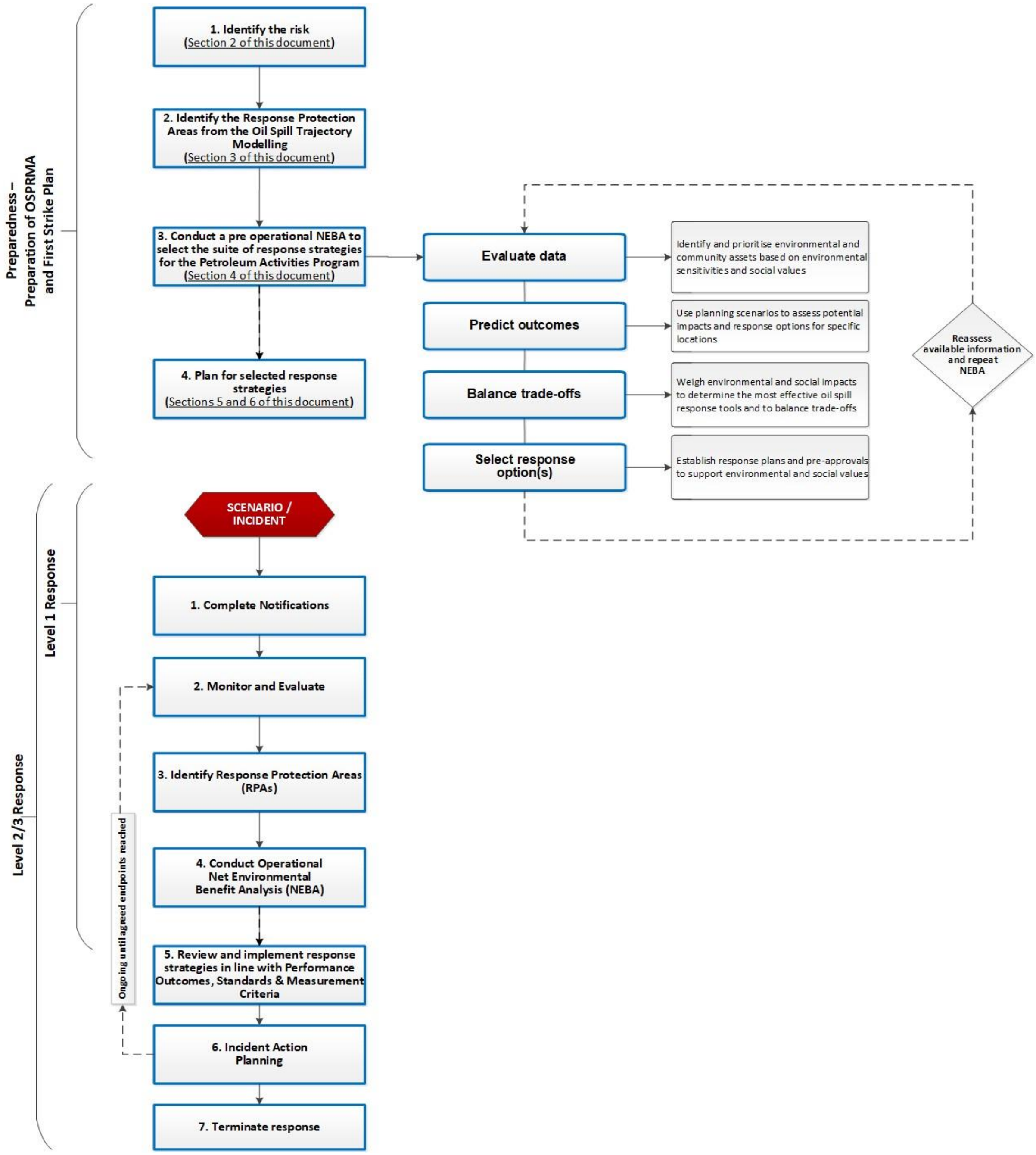

Figure 4-1: Net environmental benefit analysis (NEBA) flowchart

4.1 Pre-operational/strategic NEBA

The pre-operational NEBA identifies positive and negative impacts to sensitive receptors from implementing the response techniques. Feasibility is considered by assessing the receptors potentially impacted above response thresholds (Section 2.3.2.1) and the surface concentrations (Section 2.3.2.2) 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 using 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 scenarios

Woodside uses scenarios identified from the risk assessment in the EP to assess potential impacts and response options for specific locations. The 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 included to meet regulatory requirements. Response thresholds and deterministic modelling are then used to assess the feasibility/effectiveness and scale of the response.

Table 4-1: Scenario summary information (WCCS)

Scenario summary information (WCCS – Credible Scenario-01)	
Scenario	Hydrocarbon release surface/subsea scenario
Location	ENA-01 well location (Operational Area 1) Lat: 21° 23’ 24” S Long: 113° 55’ 48” E
Oil Type	Enfield Crude
Fate and Weathering	3% of the mass should evaporate within the first 12 hours 16% of the mass should evaporate in the first 24 hours 43% should evaporate over several days
Volume and duration of release	Total release: 14,456 m^3 (187 m^3 per day for 77 days) Surface release:1,177 m^3 (235 m^3 per day for 5 days) Seabed release: 13,279 m^3 (184 m^3 per day for 72 days)
Scenario summary information (Credible Scenario-03)	
Scenario	**Hydrocarbon release caused by accidental removal of the subsea xmas tree with an ongoing leak**
Location	Leak location (Operational Area 1) Lat: 21° 28' 54.289" S Long: 113° 59' 20.402" E
Oil Type	Enfield Crude
Fate and Weathering	3% of the mass should evaporate within the first 12 hours 16% of the mass should evaporate in the first 24 hours 43% should evaporate over several days
Volume and duration of release	Total release: 4897 m^3 (64 m^3 per day for 77 days)
Scenario summary information (Credible Scenario-05)	
Scenario	Hydrocarbon release caused by marine vessel separation
Location	Close to ENA-01 well location (Operational Area 1) Lat: 21° 23’ 24” S Long: 113° 55’ 48” 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)
Volume and duration of release	500 m^3 – instantaneous
Scenario summary information (Credible Scenario-06)	
Scenario	Hydrocarbon release caused by marine vessel collision
Location	Operational Area 2: Lat: 21° 39' 49.318" S Long: 114° 03' 34.487" 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)
Volume and duration of release	652 m^3 – instantaneous

4.2.1.1 Hydrocarbon characteristics

Enfield Crude

Enfield Crude (API 22.5) contains a high proportion (~38% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. No information has been made available to allow judgement as to whether or not the mixture will eventually solidify or sink as it weathers.

Credible Scenario-01 Hydrocarbon release surface/subsea scenario

The results of the OILMAP simulation predicted that the discharge would generate a cone of rising gas that would entrain the oil droplets and ambient sea water up to a “trapping depth” (where the gas plume becomes neutrally buoyant and its vertical velocity drops to zero) approximately 115 m above the seabed and 407 m below the surface. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of 0.8 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone at the neutral buoyancy point is predicted to be approximately 25 m.

The discharge velocity and turbulence generated by the expanding gas plume is predicted to produce large oil droplets, of diameter ranging from ~1,667-10,000 µm, which will rise to the surface at rates determined by their buoyancy relative to the surrounding water density and the viscous resistance imposed by the water. These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. With theoretical rise velocities ranging from 4.1-11.6 cm/s, the surfacing times will range from approximately 1-3 hours in the absence of turbulence or strong stratification of the water column. Floating slicks are likely to be formed under calm wind conditions.

The ongoing nature of the release combined with the potential for oil to reach 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 on the ocean surface, with the oil’s high viscosity meaning it will tend to resist entrainment under typical local wind conditions.

Credible Scenario-03 Hydrocarbon leak subsea

The results of the OILMAP simulation predicted that the discharge would generate a cone of rising gas that would entrain the oil droplets and ambient sea water up to a “trapping depth” approximately 52 m above the seabed and 463 m below the surface. The mixed plume is initially predicted to jet towards the water surface with a vertical velocity of around 0.5 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone at the neutral buoyance point is predicted to be approximately 25 m.

The discharge velocity and turbulence generated by the expanding gas is predicted to generate relatively small oil droplets (~28-167 µm) that will rise to the surface at rates (0.003-0.12 cm/s) determined by their buoyancy relative to the surrounding water density and the viscous resistance imposed by the water. These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. The largest droplets have the potential to reach the surface around 107 hours (~4.5 days) after release, in the absence of turbulence or strong stratification of the water column, and form floating slicks under amenable wind conditions. The smaller droplets will tend to remain within the wave-mixed surface layer of the water column (3-10 m deep, depending on conditions), where they can resist surfacing due to their weak buoyancy relative to other mixing processes.

Marine Diesel – Credible Scenario-05 and Credible Scenario-06

Marine Diesel is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group two oil.

Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Table 4-2: Oil fate, behaviour and impacts

Deterministic modelling results				
	Credible Scenario-01	**Credible Scenario-03**	**Credible Scenario-05**	**Credible Scenario-06**
Surface area of hydrocarbons (>50 g/m²)	Deterministic modelling predicts that there will be no surface concentration of oil at 50g/m² over the duration of the modelled period (77 days).	Deterministic modelling predicts that there will be no surface concentration of oil at 50 g/m² over the duration of the modelled period (77 days).	Full deterministic modelling was not undertaken for Credible Scenario-05 so spatial area is not available.	Surface hydrocarbons above threshold (>50 g/m² and <15,000cSt) are predicted to be: • 13 km² (133 m³) on Day 1 Surface hydrocarbons return to 0 km² (0 m³) on Day 2
Surface area of hydrocarbons (>50 g/m² and <15,000 cSt)	Deterministic modelling predicts that there will be no surface concentration of oil at 50g/m² over the duration of the modelled period (77 days). Deterministic modelling also predicts that viscosity will exceed 15,000 cSt (circa day 2-4) but fluctuates above and below threshold for the duration of the modelled period.	Deterministic modelling predicts that there will be no surface concentration of oil at 50 g/m² over the duration of the modelled period (77 days).	Full deterministic modelling was not undertaken for Credible Scenario-05 so spatial area is not available.	Surface hydrocarbons above threshold (>50 g/m2) are predicted to be: • 13 km² (133 m³) on Day 1 Surface hydrocarbons return to 0 km² (0 m³) on Day 2
Minimum time to shoreline contact (>100 g/m²)	21 days at Ningaloo Coast – Mangrove Bay (0.882 m³**)** Model 5, Q1	No contact	2.25 days (Ningaloo Coast North), 0.389 m³ Model 5, Q1	0.9 days (22 hours) (Ningaloo Coast North WHA), 19 m³ Model 5, Q1
Largest volume ashore at any single RPA (>100 g/m²)	889.935 m³ (day 46.5 – Ningaloo Coast (total) – includes Jurabi-Lighthouse Beaches, Turquoise Bay, Mangrove Bay and Yardie Creek) 410.27 m³ (day 40.5 – Lighthouse-Jurabi) 133.98 m³ (day 41.00 – Muiron Islands) Model 1, Q2	No contact	197.4 m³ (day 3.75 - Ningaloo Coast North) Model 5, Q1	139 m³ (day 2 - Ningaloo Coast North WHA) Model 42, Q2
Largest total shoreline accumulation (>100 g/m²)	514.4 m³ (day 81.5 – Barrow and Lowendal Islands) Model 13, Q4	No contact	199.99 m³ (day 3.75 - Ningaloo Coast North) Model 5, Q1	139 m³ (day 2 - Ningaloo Coast North WHA) Model 42, Q2

Response Protection Areas (RPAs)								
	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
Yardie Creek	45.75 days (6.00 m^3)	10.02 m^3 (day 53.75)	No contact	No contact	N/A	N/A	No contact	No contact
Turquoise Bay	44.5 days (8.317 m^3)	8.57 m^3 (day 87.5)	No contact	No contact	N/A	N/A	No contact	No contact
Mangrove Bay	21.0 days (0.882 m^3)	12.6 m^3 (day 52.25)	No contact	No contact	N/A	N/A	No contact	No contact
Jurabi-Lighthouse Beaches	40.5 days (410.27m^3)	410.27 m^3 (day 40.5)	No contact	No contact	N/A	N/A	No contact	No contact
Ningaloo Coast North	N/A	N/A	No contact	No contact	2.25 days (0.389 m^3)	197.4 m^3 (3.75 days)	22 hours (0.9 days) (19 m^3)	139 m^3 (day 2)
Ningaloo Coast Middle	N/A	N/A	No contact	No contact	3.5 days (0.08 m^3)	2.58 m^3 (4.25 days)	No contact at threshold	No contact at threshold
Montebello Islands	58.5 days (215.22m^3)	215.22 m^3 (day 58.5)	No contact	No contact	No contact	No contact	No contact	No contact
Barrow Island	60.0 days (4.46 m^3)	33.14 m^3 (day 81.25)	No contact	No contact	No contact	No contact	No contact	No contact
Shark Bay	54.0 days (6.855 m^3)	514.44 m^3 (day 81.5)	No contact	No contact	No contact	No contact	No contact	No contact
Abrolhos Islands	61.5 days (4.91 m^3)	4.91 m^3 (day 61.5)	No contact	No contact	No contact	No contact	No contact	No contact
Muiron Islands	41.0 days (133.98m^3)	133.98 m^3 (day 41.00)	No contact	No contact	4.5 days (0.04 m^3)	37.98 m^3 (6 days)	No contact	No contact
Pilbara Islands – Southern Islands Group	40.25 days (0.88m^3)	134.13 m^3 (day 90.25)	No contact	No contact	No contact	No contact	No contact	No contact

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.

An assessment of which response options are feasible for the scenarios is included below in Table 4-3, Table 4-4, Table 4-5 and Table 4-6. 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 and when and timings throughout the response.

Table 4-3: Response technique evaluation – Enfield crude release caused by loss of well containment (Credible Scenario-01)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Enfield Crude				
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 an Enfield Crude 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 whether the spill passes into State Waters and thus control of the incident moves to WA DoT (if a Level 2/3 event).	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 • determine when control of the spill passes the WA DoT if the spill passes into State Waters (and is a Level 2/3 incident)
Source control via light well intervention (LWI) well control package	Controlling a loss of well containment at source via LWI well control package would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	In the event of the worst-case scenario with a loss of well containment, source control via LWI well control package would be attempted.	Yes	The use of source control intervention via LWI well control package may be feasible and would reduce quantity of hydrocarbons entering the marine environment.
Source control via ROV intervention	Controlling a loss of well containment at source via ROV intervention would limit the quantity of hydrocarbon entering the marine environment.	ROV intervention is feasible via the LWI well control package or the subsea tree	Yes	Source control via ROV intervention using the LWI well control package or subsea tree may be feasible and would reduce quantity of hydrocarbons entering the marine environment.
Debris clearance	Debris clearance via ROV is an effective and necessary procedure prior to any further source control activities.	Debris clearance is a feasible, and widely accepted and utilised technique.	Yes	Debris clearance may be a necessary procedure prior to any further source control activities, if required.
Source control via 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.	Evaluation of the viability of utilising a capping stack for the NGA EP activity has concluded that it is not a feasible response strategy. The 18 subsea wells are comprised of vertical (VXT) and open water (OXT) subsea trees (xmas tree). Both VXT and OXT have incompatible connector sizes and profiles (Taurus iii 13 ⅝" connectors) with capping stacks (H4/HC 18 ¾" connector). Additionally, the 13 ⅝" connectors on top of the Enfield trees do not have the required strength to carry the loads generated by a capping stack. During well intervention activities, the use of a capping stack on top of the intervention BOP/lower marine riser (LMR) and emergency disconnect package (EDP) during an unplanned LOWC event would compromise the integrity of the subsea infrastructure which would not have the required strength to carry the intervention equipment and capping stack load. Furthermore, the xmas tree would not be removed for well intervention thus the normal tree barriers would remain active.	No	The PAP wells have vertical xmas trees upon which a capping stack cannot be utilised due to incompatibility of connector sizes, inadequate load bearing capacity and/or, if the tree remains in place, the existing barriers would be remain active.
Source control via relief well drilling	A subsea release of Enfield Crude will be over approximately 77 days. Relief well drilling will be the primary option to stop the release.	For a spill from one of the PAP wells, relief well drilling will be the primary means of controlling of well containment event. Relief well drilling is a widely accepted and utilised technique.	Yes	Relief well drilling will be the primary technique employed to control a loss of well containment event. The additional impacts introduced from drilling a relief well are comprehensively understood and are low in comparison to an ongoing release of hydrocarbons. Therefore, the environmental benefit for implementing relief well drilling outweighs the risk of implementing the response technique.
Subsea dispersant injection (SSDI)	Predicted to be effective on the subsea hydrocarbon release due to oil properties and dispersant efficacy testing results. The treatment of oil at the point of release resulting in a higher encounter rate. SSDI requires much less dispersant compared to surface spraying operations Subsurface currents and mixing energy may result in rapid three-dimensional dispersion of dispersed oi	Demonstrated feasibility internationally with the potential to treat large volumes of oil that could cause secondary contamination of wildlife or shorelines. Subsea dispersant injection (SSDI) enhances biodegradation and rapid dilution over three dimensions and, in some circumstances, can reduce VOCs at/near source therefore reducing potential health and safety risk to responders.	Yes	Application of subsea dispersant may reduce the scale and extent of surface hydrocarbons and reduce the volumes of surface hydrocarbons contacting the Ningaloo World Heritage Area. SSDI is likely to increase entrained hydrocarbon concentrations and may result in greater spreading of the entrained oil plume by increased entrainment in the water column.

	SSDI can be applied both day and night and in practically any weather conditions. Dispersed oil at depth will be predominantly small droplets that will not rise as rapidly to the upper water column where there is generally a greater abundance of marine life.			
Surface dispersant application	Predicted to be effective on the hydrocarbon based on efficacy testing.	Modelling predicts that appropriate concentrations for surface dispersant would not be present but, as a conservative approach has been included, in the instance that operational monitoring detects surface hydrocarbons at appropriate concentrations during a spill event. Potential to reduce the magnitude, probability of, extent of, contact with and accumulation on shorelines receptors. RPA with potential to be contacted by surface hydrocarbons (>100 g/m^2) is Mangrove Bay, after a minimum of 21 days of less than 1 m^3. Application of surface dispersant from aerial and vessels may reduce the volumes of hydrocarbons contacting the shorelines of the Ningaloo World Heritage Area.	**Potentially**	Potential to remove large volumes of oil from the surface that could cause secondary contamination of wildlife or shorelines. Enhances biodegradation. May reduce VOCs at/near source therefore reducing potential health and safety risk to responders. Socio-economic impacts of visible surface oil will be reduced
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 is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.	**No**	Given the poor effectiveness of mechanical dispersion and the associated risk of implementing the response for this activity, this technique is unsuitable for the PAP.
In-situ burning	In-situ burning is only effective where minimum slick thickness can be achieved and where calm metocean conditions can be ensured. Use of this technique would also cause an increase the release of atmospheric pollutants.	There is a limited window of opportunity in which this technique can be applied (prior to evaporation of the volatiles) which would be difficult to achieve. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	**No**	The safety concerns and the predicted low effectiveness associated with implementing an in-situ burning response outweigh the potential environmental benefit.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5. It has the potential to reduce the magnitude, probability, extent, contact and accumulation of hydrocarbon on shorelines receptors when suitable encounter rates can be achieved. It also has the potential to reduce the magnitude and extent of contact with submerged receptors by removing oil before further natural entraining/dissolving of hydrocarbons occurs.	Modelling predicts that appropriate concentrations for containment and recovery would not be present but, as a conservative approach has been included, in the instance that operational monitoring detects surface hydrocarbons at appropriate concentrations during a spill event. Predicted low effectiveness – typical expectation is less than 10% of hydrocarbon released can be contained and recovered. Deepwater Horizon/Macondo was approx. 3–5% with the largest containment and recovery operation ever conducted. Meteorological conditions and sea-state must allow the safe and effective deployment of booms and skimmers. Surface hydrocarbon would need to be corralled to a sufficient thickness to permit efficient recovery by skimmers. Volatile nature of the hydrocarbon likely to lead to unsafe conditions near release location.	**Potentially**	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.
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.	Real-time Operational Monitoring activities (OM01, OM02 and OM03) will be used to indicate if surface hydrocarbons are moving toward shorelines. Pre-emptive assessments of sensitive receptors at risk (OM04) and existing TRPs will then be utilised to guide shoreline protection and deflection operations. First shoreline contact is predicted from floating surface hydrocarbon on Day 21 (0.9 m^3 at Ningaloo Coast – Mangrove Bay) allowing adequate time to deploy this technique. Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	**Yes**	This technique will help protect sensitive sites from impact providing net environmental benefit.
Shoreline clean-up	Based on existing TRPs, Shoreline Clean-up is expected to be effective at removing hydrocarbon volumes ashore at identified RPAs.	Real-time Operational Monitoring activities (OM01, OM02 and OM03) will be used to indicate where hydrocarbons will contact shorelines. Pre-emptive assessments of sensitive receptors at risk (OM04) and shoreline assessments (OM05) and existing TRPs will then be utilised to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. First shoreline contact is predicted from floating surface hydrocarbon on Day 21 (0.9 m^3 at Ningaloo Coast – Mangrove Bay) 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**	This technique can help prevent remobilisation of hydrocarbon and impact on shorelines. Removal of hydrocarbons will help shorten the recovery window unless shoreline type is of a sensitive nature.

		A shoreline clean-up response will mitigate the effects of contact, reducing potential for secondary contamination to other shorelines and wildlife and reduce recovery time. It is estimated an unmitigated shoreline clean-up operation would be complete by Day 150.		
Oiled wildlife response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is achieved through rehabilitation of those already subject to contamination and also through pre-emptive capture/hazing to prevent additional wildlife from being contaminated.	The level of oiled wildlife response can be scalable based on the predicted number of animals oiled. Must be undertaken by qualified, trained wildlife response personnel. Wildlife response typically has a very high mortality rate for seabirds and waders.	**Yes**	This technique may prevent impact to and/or treat oiled wildlife providing net environmental benefit.

Table 4-4: Response technique evaluation – Enfield crude release caused by accidental removal of the subsea xmas tree with an ongoing leak (Credible Scenario-03)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Enfield Crude				
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 an Enfield Crude 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 whether the spill passes into State Waters and thus control of the incident moves to WA DoT (if a Level 2/3 event).	**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 • determine when control of the spill passes the WA DoT if the spill passes into State Waters (and is a Level 2/3 incident)
Source control via light well intervention (LWI) well control package	Controlling a loss of well containment at source via LWI well control package would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	In the event of an accidental removal of the subsea tree, source control via LWI well control package would be attempted.	**Yes**	The use of source control intervention via LWI well control package may be feasible and would reduce quantity of hydrocarbons entering the marine environment.
Source control via ROV intervention	Controlling a loss of well containment at source via ROV intervention would limit the quantity of hydrocarbon entering the marine environment.	ROV intervention is feasible via the LWI well control package or the subsea tree	**Yes**	Source control via ROV intervention using the LWI well control package or subsea tree may be feasible and would reduce quantity of hydrocarbons entering the marine environment.
Debris clearance	Debris clearance via ROV is an effective and necessary procedure prior to any further source control procedures.	Debris clearance is a feasible, and widely accepted and utilised technique.	**Yes**	Debris clearance may be a necessary procedure prior to any further source control activities, if required.
Source control via 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.	Evaluation of the viability of utilising a capping stack for the NGA EP activity has concluded that it is not a feasible response strategy. The 18 subsea wells are comprised of vertical (VXT) and open water (OXT) subsea trees (xmas tree). Both VXT and OXT have incompatible connector sizes and profiles (Taurus iii 13 ⅝" connectors) with capping stacks (H4/HC 18 ¾" connector). Additionally, the 13 ⅝" connectors on top of the Enfield trees do not have the required strength to carry the loads generated by a capping stack. During well intervention activities, the use of a capping stack on top of the intervention BOP/lower marine riser (LMR) and emergency disconnect package (EDP) during an unplanned LOWC event would compromise the integrity of the subsea infrastructure which would not have the required strength to carry the intervention equipment and capping stack load. Furthermore, the xmas tree would not be removed for well intervention thus the normal tree barriers would remain active. In the case of damage to the tree due to anchor drag or dropped object, the loss of well integrity would be below the subsea tree and the release	**No**	The PAP wells have vertical xmas trees upon which a capping stack cannot be utilised due to incompatibility of connector sizes, inadequate load bearing capacity and/or, if the tree remains in place, the existing barriers would be remain active.

		point would not be through the main bore of the tree thus placing a capping stack on top of the tree would be ineffective in ceasing the release. Removing the tree during a LOWC in these circumstances to place a capping stack on the wellhead would exacerbate the LOWC, increasing it from a restricted flow via the damaged tree to a full-bore release via the wellhead. Furthermore, damage to the tree caused by a dropped or dragged anchor is likely to also damage the wellhead connector and affect the inclination and/or sealing capability of the wellhead preventing successful deployment of a capping stack.		
Source control via relief well drilling	The subsea leak of Enfield Crude will be over approximately 77 days. Relief well drilling will be the primary option to stop the release.	For a spill from one of the PAP wells, relief well drilling will be the primary means of controlling of well containment event. Relief well drilling is a widely accepted and utilised technique.	**Yes**	Relief well drilling will be the primary technique employed to control a well leak event. The additional impacts introduced from drilling a relief well are comprehensively understood and are low in comparison to an ongoing release of hydrocarbons. Therefore, the environmental benefit for implementing relief well drilling outweighs the risk of implementing the response technique.
Subsea dispersant injection (SSDI)	Predicted to be effective on the subsea hydrocarbon release due to oil properties and dispersant efficacy testing results. The treatment of oil at the point of release results in a higher encounter rate. SSDI requires much less dispersant compared to surface spraying operations Subsurface currents and mixing energy may result in rapid three-dimensional dispersion of dispersed oil. SSDI can be applied both day and night and in practically any weather conditions. Dispersed oil at depth will be predominantly small droplets that will not rise as rapidly to the upper water column where there is generally a greater abundance of marine life.	Modelling predicts that oil droplets will be relatively small (~28-167 µm) and will take around 107 hours (4.5 days) to reach the surface thus the use of subsea dispersant injection would provide little additional benefit over natural dispersion. This is coupled with a relatively small daily release of 63.6 m^3.	**No**	Due to the predicted behaviour of the subsea plume, particularly the small droplet size together with the relatively small daily release, the use of subsea dispersant injection would be unwarranted and could unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.
Surface dispersant application	Application of surface dispersant would likely reduce the volumes of hydrocarbons contacting sensitive receptors. It has the potential to remove large volumes of oil from the surface that could cause secondary contamination of wildlife or shorelines. Dispersant can also enhance biodegradation and may reduce VOCs therefore reducing potential health and safety risk to responders.	<u>Modelling undertaken does not predict any surface hydrocarbon at response thresholds appropriate for surface dispersant use (>50 g/m^2) for the duration of the leak.</u>	**No**	Due to the predicted lack of surface hydrocarbon at appropriate surface thresholds (>50 g/m^2), the use of surface dispersant would be unwarranted and could unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons and would not provide a net environmental benefit.
Mechanical dispersion	Mechanical dispersion involves the use of a vessel's prop wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. However, this technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the technique is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. The volatile nature of the oil is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.	**No**	Given the poor effectiveness of mechanical dispersion and the associated risk of implementing the response for this activity, this technique is unsuitable for the PAP.
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.	<u>Modelling undertaken does not predict any surface hydrocarbon at response thresholds appropriate for in situ burning for the duration of the leak.</u> 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.	**No**	The safety concerns and the predicted low effectiveness associated with implementing an in-situ burning response outweigh the potential environmental benefit.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5. It has the potential to reduce the magnitude, probability of, extent of, contact with and accumulation of hydrocarbon on shorelines receptors. It also has the potential to reduce the magnitude and extent of contact with submerged receptors by entrained/ dissolved hydrocarbons.	<u>Modelling undertaken does not predict any surface hydrocarbon at response thresholds appropriate for containment and recovery (>50 g/m^2) for the duration of the leak.</u> In addition, this technique can have low effectiveness with on average, <10% of available oil contained and recovered. The largest operation ever mounted was during the Deepwater Horizon/Macondo which achieved an effectiveness of approximately 3-5%. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues.	**No**	Due to the predicted lack of surface hydrocarbon at appropriate surface thresholds (>50 g/m^2), containment and recovery would not be a feasible response technique. Furthermore, it has a very low effectiveness.

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.	For Credible Scenario-03, there is no predicted impact at threshold, however, 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). Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	**Yes**	RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are deemed to be at risk, based on real-time modelling during a spill event, shoreline protection and deflection techniques will be employed to minimise hydrocarbon contact providing net environmental benefit.
Shoreline clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	For Credible Scenario-03, there is no predicted impact at threshold, however, 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), 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). 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.	For Credible Scenario-03, there is no predicted impact at threshold, however, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken in accordance with the Wildlife Response Operational Plan as and where required. In addition, any rehabilitation could only be undertaken by trained specialists. Response options may be limited to hazing to ensure the safety of response personnel.	**Yes**	This technique may prevent impact to and/or treat oiled wildlife providing net environmental benefit.

Table 4-5: Response technique evaluation – marine diesel release caused by marine vessel separation (Credible Scenario-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 which 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.	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 (vessel)	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 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.	Marine diesel is prone to rapid spreading and evaporation thus the use of dispersant would be deemed an unnecessary response technique.	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 is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.	No	Given the poor effectiveness of mechanical dispersion and the associated risk of implementing the response for this activity, this technique is unsuitable for the PAP.
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.	No	Diesel characteristics are not appropriate for the use of in-situ burning and would unnecessarily cause an increase the release of atmospheric pollutants.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5.	Marine diesel is prone to rapid spreading and evaporation thus reducing the feasibility of containment and recovery as a response technique.	No	Containment and recovery would be an inappropriate response technique as it requires the spilled hydrocarbon to be BAOAC 4 or 5 with a 50-100% coverage of 100 g/m^2 to 200 g/m^2 which a spill of marine diesel would not achieve. In addition, most of the spilled diesel would have been subject to rapid 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.	Use of shoreline protection and deflection for a spill of marine diesel is unlikely to provide any significant environmental benefit as the diesel will be subject to rapid spreading and evaporation prior to contact with any sensitive areas. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time. Due to potentially high levels of volatiles from a spill of marine diesel, shoreline protection and deflection would only be undertaken if safe for response personnel.	Potentially	Protection and deflection may be deployed to prevent contamination of sensitive resources if operational monitoring identifies areas at risk of impact and only if volatile levels are safe for responders. RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event.

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 prior to impacting any sensitive receptors. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time. The modelling indicates that there is a very low probability of an impact from a marine diesel spill and that in the event of an impact the diesel would continue to evaporate and decay rapidly post-impact. Due to potentially high levels of volatiles from a spill of marine diesel, shoreline clean-up would only be undertaken when safe for response personnel.	**Potentially**	Shoreline clean-up may be undertaken if sensitives receptors are impacted at levels that would permit an effective response and only if volatile levels are safe for responders. RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event.
Oiled wildlife	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 would be limited to hazing to ensure the safety of response personnel. In addition, any rehabilitation could only be undertaken by trained specialists.	**Yes**	The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. However, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken as and where required.

Table 4-6: Response technique evaluation – marine diesel release caused by marine vessel collision (Credible Scenario-06)

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 which 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.	**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 (vessel)	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 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.	Marine diesel is prone to rapid spreading and evaporation thus the use of dispersant would be deemed an unnecessary response technique.	**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 is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.	**No**	Given the poor effectiveness of mechanical dispersion and the associated risk of implementing the response for this activity, this technique is unsuitable for the PAP.
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.	**No**	Diesel characteristics are not appropriate for the use of in-situ burning. It would unnecessarily cause an increase the release of atmospheric pollutants, and the associated risk of implementing the response makes this technique unsuitable for this scenario.

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.	Marine diesel is prone to rapid spreading and evaporation thus reducing the feasibility of containment and recovery as a response technique. Furthermore, entering a volatile environment to undertake this technique would be unsafe for response personnel.	**No**	Although this scenario results in surface oil of BAOAC 4, this only occurs within the first 24 hours during which time volatile levels would be very high and unsafe for response personnel.
Shoreline protection and deflection	Shoreline protection and deflection can be effective at preventing contamination of at-risk areas.	Use of shoreline protection and deflection for a spill of marine diesel, under the circumstances associated with Credible Scenario-06, may assist in protecting nearby sensitive areas and thus provide an environmental benefit. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time. Due to potentially high levels of volatiles from a spill of marine diesel, shoreline protection and deflection would only be undertaken if safe for response personnel.	**Yes**	Protection and deflection may be deployed to prevent contamination of sensitive resources if operational monitoring identifies areas at risk of impact and only if volatile levels are safe for responders. RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event.
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.	Real-time Operational Monitoring activities (OM01, OM02 and OM03) will be used to indicate where hydrocarbons will contact shorelines. Pre-emptive assessments of sensitive receptors at risk (OM04) and shoreline assessments (OM05) and existing TRPs will then be utilised to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. Modelling indicates that first shoreline contact is predicted from floating surface hydrocarbon at threshold concentrations of 100 g/m^2 on day 0.9 (22 hours) (19 m^3 at Ningaloo Coast North WHA). An impact of marine diesel would continue to evaporate and decay rapidly post-impact and result in potentially high levels of volatiles thus shoreline clean-up would only be undertaken if safe for response personnel.	**Yes**	RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are at risk, based on real-time operational monitoring 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 but would only be deployed once volatile levels are safe for responders.
Oiled wildlife	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 would be limited to hazing to ensure the safety of response personnel. In addition, any rehabilitation could only be undertaken by trained specialists.	**Yes**	If safe to deploy, wildlife response may prevent impact to and/or treat oiled wildlife thus providing a net environmental benefit.

4.2.3 Exclusion of response techniques

Response techniques that are not feasible for both scenario (Credible Scenario-01 or Credible Scenario-05) for the Nganhurra Cessation of Operations are detailed in the subsections below and are excluded from further assessment within this document.

4.2.3.1 Source control via capping stack deployment

Evaluation of the viability of utilising a capping stack for the NGA EP activity has concluded that it is not a feasible response strategy. The 18 subsea wells are comprised of vertical (VXT) and open water (OXT) subsea trees (xmas tree). Both VXT and OXT have incompatible connector sizes and profiles (Taurus iii 13 ⅝" connectors) with capping stacks (H4/HC 18 ¾" connector). Additionally, the 13 ⅝" connectors on top of the Enfield trees do not have the required strength to carry the loads generated by a capping stack.

During well intervention activities, the use of a capping stack on top of the intervention BOP/lower marine riser (LMR) and emergency disconnect package (EDP) during an unplanned LOWC event would compromise the integrity of the subsea infrastructure which would not have the required strength to carry the intervention equipment and capping stack load. Furthermore, the xmas tree would not be removed for well intervention thus the normal tree barriers would remain active.

In the case of damage to the tree due to anchor drag or dropped object, the loss of well integrity would be below the subsea tree and the release point would not be through the main bore of the tree thus placing a capping stack on top of the tree would be ineffective in ceasing the release. Removing the tree during a LOWC in these circumstances to place a capping stack on the wellhead would exacerbate the LOWC, increasing it from a restricted flow via the damaged tree to a full-bore release via the wellhead. Furthermore damage to the tree caused by a dropped or dragged anchor is likely to also damage the wellhead connector and affect the inclination and/or sealing capability of the wellhead preventing successful deployment of a capping stack.

Woodside does, however, maintain capability for well intervention, debris clearance and capping stack as part of expected industry practice.

4.2.3.2 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.

4.2.3.3 In-situ burning

This technique requires calm sea state conditions as is required for containment and recovery operations, which limits its feasibility in Exmouth 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 Exmouth region it is expected that the ability to contain oil may be limited as the sea state may exceed the optimum conditions. It is preferable that oil is fresh and does not emulsify to maximise burn efficiency and reduce residue thickness.

There are health and safety risks for response personnel associated with the containment and subsequent burning of hydrocarbons. It is also suggested that the residue from attempts to burn would sink, thereby posing a risk to the environment. The longer-term effects of burn residues on the marine environment are not fully understood and therefore, no assessment of the potential environmental impact can be determined.

Until further operational and environmental information becomes available, Woodside will not consider this option.

4.2.3.4 Surface dispersant application – marine diesel

Marine diesel is prone to rapid spreading and evaporation thus the use of dispersant would be deemed an unnecessary response technique. 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.

4.2.3.5 Containment and Recovery – marine diesel

Marine diesel is prone to rapid spreading and evaporation thus reducing the feasibility of containment and recovery as a response technique. Furthermore, entering a volatile environment to undertake this technique would be unsafe for response personnel. Although this scenario results in surface oil of BAOAC 4, this only occurs within the first 24 hours during which time volatile levels would be very high and unsafe for response personnel.

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. The NEBA can be found in ANNEX A: Net Environmental Benefit Analysis detailed outcomes.

4.5 Stage 4: Select best response options

To select the response technique, all the other stages in the NEBA process are considered and used to establish response plans and any pre-approvals to support protection of identified environmental and social values.

The response techniques implemented may vary according to a particular spill. The hydrocarbon type released and the sensitivities of the receptors (both ecological and socio-economic) may influence the response. The pre-operational NEBA broadly evaluates each response technique and supports decisions on whether they are feasible and of net environmental benefit. Response techniques that are not feasible or beneficial are rejected at this stage and not progressed to planning.

Further risks and impacts from implementing these selected response options are outlined in Section 7.

Table 4-7: Selection and prioritisation of response techniques

Response planning scenario	Key characteristics for response planning (minimum times to contact for first receptor and/or shoreline contacted above response threshold)	Feasibility of response techniques: Monitor and evaluate	Source control – LWI well control package via ROV or subsea tree	Debris clearance	Source control – capping stack	Source control on the vessel	Source control – relief well drilling	Subsea dispersant injection	Surface dispersant application	Mechanical dispersion	In-situ burning	Containment and recovery	Shoreline protection and deflection	Shoreline cleanup	Oiled wildlife response	Outline response technique
Credible Scenario-01: Uncontrolled release of Enfield crude caused by loss of well containment. Total: 187.84 m^3 per day for 77 days Surface: 235.40 m^3 per day for 5 days Seabed: 184.43 m^3 per day for 72 days Residual component of 38.4%	Fastest contact: Mangrove Bay (21 days) Maximum accumulation: 514.44 m^3 (day 81.5 – Barrow and Lowendal Islands)	Yes	Yes	Yes	No	N/A	Yes	Yes	Potentially	No	No	Potentially	Yes	Yes	Yes	Monitor and evaluate. Initiate intervention via LWI well control package and ROV Initiate debris clearance. Initiate subsea dispersant injection. Initiate relief well drilling. Consider surface dispersant viability and implement if a net environmental benefit is determined. Consider containment and recovery viability and implement if a net environmental benefit is determined. Plan for shoreline protection and deflection (in liaison with WA DoT) if there is potential contact predicted. Plan for shoreline monitoring and clean-up (in liaison with WA DoT) where contact predicted. Plan for oiled wildlife response and implement if oiled wildlife is observed.
Credible Scenario-03: Uncontrolled release of Enfield Crude caused by accidental removal of the subsea xmas tree with an ongoing leak Total: 64 m^3 per day for 77 days Residual component of 38.4%	Fastest contact: *No shoreline contact predicted* Maximum accumulation: *No shoreline contact predicted*	Yes	Yes	Yes	No	N/A	Yes	No	No	No	No	No	Yes	Yes	Yes	Monitor and evaluate. Initiate intervention via LWI well control package and ROV Initiate debris clearance. Initiate relief well drilling. Consider shoreline protection and deflection (in liaison with WA DoT) if there is potential contact predicted. Consider shoreline monitoring and clean-up (in liaison with WA DoT) where contact predicted. Plan for oiled wildlife response and implement if oiled wildlife is observed.
Credible Scenario-05: Hydrocarbon release caused by marine vessel separation. Instantaneous release of 500 m^3 of marine diesel within the Operational Area. Residual	Fastest contact: 2.25 days (0.389 m^3 at Ningaloo Coast North Maximum accumulation: 199.99 m^3 (day 3.75 - Ningaloo Coast North)	Yes	N/A	N/A	N/A	Yes	N/A	N/A	No	No	No	No	Potentially	Potentially	Yes	Monitor and evaluate. Initiate source control if feasible. Consider shoreline protection and deflection (in liaison with WA DoT) if safety of responders can be ensured with regard to the potentially high level of volatiles. Consider shoreline clean-up (in liaison with WA DoT) if safety of responders can be ensured with regard to the potentially high level of volatiles.

component of 25 m^3 (5%)																Plan for oiled wildlife response and implement if oiled wildlife is observed.
Credible Scenario-06: Hydrocarbon release caused by marine vessel collision. Instantaneous release of 652 m^3 of marine diesel within Operational Area 2. Residual component of 32.6 m3 (5%)	Fastest contact: 0.9 days (19 m^3 at Ningaloo Coast North WHA Maximum accumulation: 139 m^3 (day 2 - Ningaloo Coast North WHA)	Yes	N/A	N/A	N/A	Yes	N/A	N/A	No	No	No	No	Yes	Yes	Yes	Monitor and evaluate. Initiate source control if feasible. Consider shoreline protection and deflection (in liaison with WA DoT) if safety of responders can be ensured with regard to the potentially high level of volatiles. Consider shoreline clean-up (in liaison with WA DoT) if safety of responders can be ensured with regard to the potentially high level of volatiles. Plan for oiled wildlife response and implement if oiled wildlife is observed.

From the NEBA undertaken on the WCCS identified, the potential response techniques are;

- Monitor and evaluate (all scenarios)
- Source control – LWI well control package via ROV or subsea tree (Credible Scenario-01 and Credible Scenario-03)
- Debris clearance (Credible Scenario-01 and Credible Scenario-03)
- Source control on the vessel (Credible Scenario-05 and Credible Scenario-06)
- Source control via relief well drilling (Credible Scenario-01 and Credible Scenario-03)
- Subsea dispersant injection (Credible Scenario-01)
- Surface dispersant application (if operational monitoring determines concentrations at appropriate thresholds) (Credible Scenario-01)
- Containment and recovery (if operational monitoring determines concentrations at appropriate thresholds) (Credible Scenario-01)
- Shoreline protection and deflection at identified RPAs (all scenarios)
- Shoreline clean-up on priority impacted coastlines (all scenarios)
- Oiled wildlife response (all scenarios)

Support functions include:

- Waste management (all scenarios)
- Scientific monitoring programs (all scenarios).

5 HYDROCARBON SPILL ALARP PROCESS

Woodside's hydrocarbon spill ALARP process is aligned with guidance provided by NOPSEMA in *Guideline N-04750-GL1687* (2016) and is set out in the 'Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) Guidelines'.

From the identified response planning need and pre-operational NEBA, Woodside conducts a structured, semi-quantitative hydrocarbon spill process which has the following steps:

1. Considers the Response Planning Need identified in terms of surface area (km^2) and available surface hydrocarbon volumes (m^3) against existing Woodside capability;
2. Considers alternative, additional, and improved options for each response technique/control measure by providing an initial and, if required, detailed evaluation of;
    - Predicted cost associated with adopting the control measure,
    - Predicted change/environmental benefit, and
    - 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; or
    - No identified reasonably practicable additional, alternative and/or improved control measures would provide further overall increased proportionate environmental benefit; or
    - No reasonably practical additional, alternative, and/or improved control measures have been identified.
3. Where an alternative, additional and/or improved control measure is adopted, a measurable level of environmental performance has been assigned.
4. Higher order impacts/ risks have received more comprehensive alternative, additional, and improved control measure evaluations and do not just compare the cost of the adopted control measures to the costs of an extreme or clearly unreasonable control measure.
5. Cumulative effects have been analysed when considered in combination across the whole activity.

The response technique selection is based on the risk assessment conducted in the EP. The risk assessment identifies the type of oil, volume of release, duration of release, predicted fate, weathering and the EMBA (along with other requirements such as time to impact and predicted volumes ashore). Modelling is then used to inform the NEBA and the prioritisation of suitable response options. The scale of the response techniques selected in the pre-operational NEBA is informed through the assessment of results from deterministic modelling.

For the purpose of the ALARP assessment, the following terms and definitions have been used:

- Response techniques are considered the control measures that reduce consequences from hydrocarbon spill events. The terms 'response technique' and 'control measure' are used interchangeably.

- Cost is defined as the time, effort and/or trouble taken in financial, safety, design/storage/installation, capital/lease, and/or operations/maintenance terms to adopt a control measure.
- Where the predicted change to environmental impact is compared against standard environmental values and sensitivities impacts using positive or negative criteria from the NEBA Impact Ranking Classification Guidance in ANNEX A: Net Environmental Benefit Analysis detailed outcomes.

5.1 Monitor and evaluate (including operational monitoring)

Monitor and evaluate includes the gathering and evaluation of data to inform the oil spill response planning and operations. It includes fate and trajectory modelling, spill tracking, weather updates and field observations. This response option is deployed in some capacity for every event.

The table below provides the operations 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 Exmouth to the spill event location means that monitoring of the spill can be undertaken in a relatively short timeframe.

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.
- The shortest timeframe that shoreline contact from floating oil is predicted is 0.9 days at Ningaloo Coast North WHA (19 m^3) for Credible Scenario-06, 2.25 days at Ningaloo Coast North (0.389 m^3) for Credible Scenario-05 and 21 days at Mangrove Bay (0.882 m^3) For Credible Scenario-01. No shoreline impact is predicted for Credible Scenario-03.
- The time to contact for oil at concentrations of entrained hydrocarbons greater than 500 ppb at shoreline receptors is 1 hour at Ningaloo Coast North WHA and Ningaloo Recreational Use Zone for Credible Scenario-06, greater than 10 ppb at shoreline receptors is 8 hours at Gascoyne Marine Park for Credible Scenario-01 and, at greater than 340 ppb, is 10 hours at Gascoyne Marine Park for Credible Scenario-05.
- 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 extend up to 77 days with response operations extending up to 150 days (5 months) based on the predicted time to complete shoreline clean-up operations.
- The location, trajectory and fate of the spill will be verified by real-time spill tracking via modelling, direct observation and remote sensing (OM01, OM02, OM03, OM04 and OM05).

5.1.2 Environmental performance based on need

Table 5-2: Environmental performance – monitor and evaluate

Environmental Performance Outcome		To gather information from multiple sources to establish an accurate common operating picture as soon as possible and predict the fate and behaviour of the spill to validate planning assumptions and adjust response plans as appropriate to the scenario.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
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 techniques.	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 techniques.	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 Cleanup 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 operational SIMA confirms conventional methods are unsafe or not possible.	1, 2, 3C, 4
6	Pre-emptive assessment of sensitive receptors	6.1	Within 2 days, 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	Within 2 days, in agreement with WA DoT (for Level 2/3 incidents), deployment of 2 specialist(s) in SCAT from resource pool for each of the Response Protection Areas (RPAs) with predicted impacts.	1, 2, 3B, 3C, 4
		7.2	SCAT reports provided to IMT daily detailing the assessed areas to maximise effective utilisation of resources	1, 3B, 4
		7.3	Shoreline access routes with the least environmental impact identified will be selected by a specialist in SCAT operations	1

The control measures and capability of Woodside and its third-party service providers are shown to support Monitor and Evaluate activities up to and including the identified WCCS. This is demonstrated by the following:

- Woodside has a documented, structured and tested capability for Monitor and Evaluate operations including internal trajectory modelling capabilities, tracking buoys located offshore and contracted aerial observation platforms with access to trained observers.
- Woodside and its third-party service providers ensure there is sufficient capability for the duration of the response.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.1.
- The health and safety, financial, capital and operations/maintenance costs of implementing the alternative, additional or improved control measures identified and not carried forward are considered clearly disproportionate to the environmental benefit gained and/or not reasonably practicable for this PAP.
- The Monitor and Evaluate capability outlined in this section is part of the response developed to manage potential risks and impacts associated with the scenarios to ALARP, and there are no further additional, alternative and improved control measures other than those implemented that would provide further benefit.

5.2 Source control and well intervention

The worst-case credible scenario (Credible Scenario-01), is considered to be major damage to, or complete loss of, the xmas tree from a producing well. This scenario would result in an uncontrolled flow of 14,456 m^3 of oil from the well over 77 days as outlined in the EP. In the event of a complete break or separation of the tree, the primary response would be relief well drilling. The accidental removal of the subsea xmas tree with an ongoing leak scenario (Credible Scenario-03) is of a significantly lesser volume, is of the same duration and the same (or fewer) source control techniques would be applicable thus response planning is based upon Credible Scenario-01 only.

Woodside is a signatory to the APPEA Memorandum of Understanding (MoU) between Australian offshore operators to provide mutual aid to facilitate and expedite mobilising a mobile offshore drilling unit (MODU) and drilling a relief well, if a subsea scenario incident were to occur. The MoU commits the signatories to share rigs, equipment, personnel and services to assist another operator in need.

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)
  - a relief well is drilled and first attempt at well kill within 77 days
- 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 extend up to 77 days with response operations extending to 150 days (5 months) 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	
Safety considerations	Source control operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site, in accordance with the Woodside Management System (WMS). Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.
Feasibility considerations	Woodside's primary source control option would be ROV intervention followed by relief well drilling for the PAP wells. The following approaches outline Woodside's hierarchy for relief well drilling • Primary relief well – review internal drilling programs and MODU availability to source an appropriate rig operating within Australia with an approved Safety Case • Alternate relief well – source and contract a MODU through APPEA MOU that is operating within Australia with an approved Safety Case

	• Contingency relief well – if required, source and contract a MODU outside Australia with an approved Australian Safety Case

5.2.2 Environmental performance based on need

Table 5-4: Environmental performance – source control

Environmental Performance Outcome		To stop the flow of hydrocarbons into the marine environment.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
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	Identify source control vessel availability within 24 hours and begin contracting process. Vessel mobilised to site for deployment within 12 days for SSDI.	1, 3B, 3C
		9.3	Wild Well Control Inc (WWCI) staff available all year round to assist with the mobilisation, deployment, and operation of well intervention equipment.	1, 3B, 3C
		9.4	MODU mobilised to site for relief well drilling within 21 days.	1, 3C
		9.5	First well kill attempt completed within 77 days.	1, 3B, 3C
		9.6	Open communication line(s) to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		9.7	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
		9.8	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
		10.4	Monthly monitoring of registered operators, and Woodside will maintain minimum safe operating standards that can be provided to MODU and vessel operators for Safety Case	1, 3B, 3C
11	Safety case	11.1	Woodside will prioritise MODU or vessel(s) for intervention work(s) that have an existing safety case	1, 3C
		11.2	Woodside Planning, Logistics, and Safety Officers (on-roster/ call 24/7) to assist in expediting the safety case assessment process as far as practicable.	1, 3C
		11.3	Woodside will maintain minimum safe operating standards that can be provided to MODU and vessel operators for safety case guidance	1, 3C

The resulting source control capability has been assessed against the WCCS. The range of techniques provides 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 disproportionate to the insignificant environmental benefit gained and/or not reasonably practicable for this PAP.

- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.2.

5.3 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 vessel.

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 the WCCS vessel collision event, 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 of the EP. The vessel master’s roles and responsibilities are described in Section 7 of the EP.

Performance standards for the contracted PAP vessel are detailed in the vessel’s specific SOPEP.

- 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 the vessel SOPEP.
- The health and safety, financial, capital and operations/maintenance costs of implementing alternative, additional or improved control measures are considered disproportionate to the environmental benefit gained and/or not reasonably practicable for this PAP.
- The vessel source control capability outlined in the SOPEP is part of the response developed to manage potential risks and impacts associated with the scenarios to ALARP, and there are no further additional, alternative and improved control measures other than those implemented that would provide further benefit.

5.4 Subsea dispersant injection

Subsea dispersant injection involves the deployment of a subsea dispersant manifold with associated equipment to inject chemical dispersant directly into the oil plume in the event of a loss of well control. As it may take some time to mobilise subsea dispersant equipment, surface dispersants are generally used in the interim to treat oil that makes it to the surface.

The use of subsea dispersants has similar benefits to surface dispersant application including a potential reduction in the volume of hydrocarbons that reach the shoreline thereby reducing impacts to sensitive receptors. In addition to these benefits, subsea dispersant application may reduce volatile organic compound (VOC) levels during surface response operations, reducing risks and hazards to responders.

The *Subsea Dispersants Operational Plan* details the mobilisation and resource requirements for dispersant operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

5.4.1 Response need based on predicted consequence parameters (Credible Scenario-01)

The following statements identify the key parameters upon which a response need can be based:

- The maximum subsea hydrocarbon release is predicted to be approximately 184 m^3/day over 72 days until the well is killed.
- Ability to treat a large proportion of the daily hydrocarbon release volumes.
- A subsea dispersant injection system with sufficient coiled tubing for water depth.
- Arrangements for support organisations who provide specialist services, including subsea plume monitoring, or resources should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- The duration of the spill may extend up to 77 days with response operations extending to 150 days (5 months) based on the predicted time to complete shoreline clean-up operations.

In addition, a number of assumptions are required to estimate the response need for Subsea Dispersant Injection. These assumptions have been described in the table below.

Table 5-5: Response planning assumptions – subsea dispersant injection

Response Planning Assumptions	
Safety considerations	Subsea dispersant operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.
Technique	**Application parameters [5]**
Subsea Dispersant Injection	The predicted performance range for SSDI is based on; • total rate of subsea released oil available for SSDI, • subsea inspection (ROV) observing oil release and technique safe for deployment, • dispersant to oil application at 1:60-1:100 (used to determine the volume of dispersant required), • predicted dispersant effectiveness of 50-60% of contacted subsea oil (based upon industry research).
SSDI operation	• 1 x SSDI operation includes: – 1 x suitable installation support vessel (ISV) (vessel specifications as per Source Control and Well Intervention Plan) – subsea dispersant delivery system – work class ROV with ancillaries and hydraulic power unit (HPU) – dispersant pump – down hole line / coiled tubing – trained ROV operator(s) – trained subsea specialists
Dispersant delivery (per operation)	• Lower – 60m^3 per 24 hours • Upper – 75m^3 per 24 hours

[5] Performance ranges outlined are indicative for response planning purposes. Where actual figures and concentrations exist based on deterministic modelling or laboratory results, these will be used for response and capability planning.

5.4.2 Environmental performance based on need

Table 5-6: Environmental performance – subsea dispersant injection

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors and increase the bioavailability of hydrocarbons for microbial breakdown.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
12	Subsea spraying	12.1	Contract in place to provide Subsea Dispersant equipment resources (via SFRT)	1, 3B, 3C, 4
		12.2	Oceaneering support staff available all year round, via contract, to assist with the mobilisation, deployment, and operation of the SFRT equipment.	
		12.3	Subsea Dispersant vessel will have the following minimum specifications: • Compensated seabed crane up to 36 MT • Mobilised to site for deployment within 12 days	1, 3A, 3C, 4
		12.4	Per day dispersant log completed to record quantity of dispersants applied	1, 3A, 3B
		12.5	Contract in place with WWCI to provide SSDI and debris clearance equipment and trained personnel	1, 3B, 3C, 4
13	Support vessels	13.1	At least two communication methods, one of which will include the capability to communicate with aviation.	1, 3C, 4
		13.2	Quarterly monitoring of the availability of ISVs through existing Frame Agreements and market intelligence to meet specifications for subsea dispersant injection.	3C, 4
		13.3	Frame agreements for ISVs require vessels to maintain in-force safety case approvals covering ROV operations and provide support in the event of an emergency.	1, 3B, 3C
		13.4	Monitoring of NOPSEMA's list of registered operators and cross reference against their locations and minimum specifications for SSDI vessels	1, 3A, 4
14	Dispersant	14.1	Year-round access to 5,000m^3 of dispersant located globally which is ready to be mobilised within 24-48 hours under activation of GDS membership.	1, 3A, 3B, 3C, 3D, 4
		14.2	Year-round access to additional dispersant stockpiles via memberships with OSRL and AMOSC.	
		14.3	OSCA approved dispersants prioritised for surface and subsea use	1, 3A, 3B, 3C, 4

The resulting subsea dispersant injection capability has been assessed against the WCCS. The average maximum volume of subsea hydrocarbon released is estimated to be approximately 187.3 m^3/day for 11 weeks/ 77 days until the well is killed.

Dispersant efficacy testing has not been undertaken for subsea conditions, but industry experience estimates a subsea amenability to dispersant of approximately 50-60% effectiveness.

The SSDI capability currently available provides the capacity to treat 1,800-4,500 m^3 of subsea hydrocarbons per day with the application of 60-75 m^3 per day of dispersant. The release rates for the PAP wells are within this range and therefore the SSDI is considered a primary response technique for the subsea loss of well control scenarios and the capability is deemed sufficient.

Under optimal conditions, during the subsea release period the capability available meets the need identified and indicates that, the subsea dispersant capability has the following expected performance(s):

- Response modelling of Credible Scenario-01 (three replicates) was conducted with and without subsea dispersant operations. The greatest benefit of dispersants in this situation may be a reduction in overall shoreline accumulation over the duration of the simulation rather than an extension of the time to initial contact. The replicates specifically demonstrated a reduction in the scale, extent and volumes of surface hydrocarbons contacting identified RPAs.

- Entrained hydrocarbon concentrations in the water column are predicted to increase at most subsurface receptor locations, with dispersant application from the trapping of treated entrained hydrocarbons at a lower depth (from subsea dispersant application) due to the greatly reduced droplet size and therefore reduced buoyancy.
- The scope of the Frame Agreement Vessel Safety Case includes a range of subsea activities that would cover the requirement for SSDI operations such as subsea manifold installation, commissioning, cargo transfer (including bulk liquids), operating as a stable platform for activities including ROV operations, and accommodation support alongside or within the 500m safety zone of an existing facility which may be in production.
- An SSDI vessel can be activated and mobilised within 12 days. Detailed breakdown of this timing is included in Section 6.3. Whilst Woodside will make every endeavour to accelerate the activities to reduce this timeframe, Woodside believes that the timeframe outlined is appropriate and realistic to ensure these activities can be completed reliably.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.3.

5.5 Surface dispersant application

Surface dispersant application may reduce surface hydrocarbons and therefore prevent, or reduce the scale of, shoreline contact. Priority would be placed on treating high volume surface hydrocarbons closest to the release location as this is where high surface concentrations are predicted, and dispersant application is expected to achieve the greatest environmental benefit (refer to Annex A).

Weathering of the hydrocarbons would reduce dispersant efficacy. In the event of an ongoing loss of well control, modelling predicts hydrocarbons reaching the surface may be spread below effective response thresholds. Surface dispersant application is weather and sea-state dependent. Periods of downtime can be expected.

The Surface Dispersant Operational Plan details the mobilisation and resource requirements for dispersant operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

5.5.1 Response need based on predicted consequence parameters

Deterministic modelling conducted for the Credible Scenario-01 loss of well control scenario predicts that, for the duration of the spill, surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for surface dispersant application operations to be effective. As a conservative approach, Woodside has included surface dispersant spraying as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed. Due to the lack of supporting results from the modelling, surface dispersant spraying is not intended as a primary response technique.

The following statements identify the key parameters upon which response need is based for each scenario:

- Although the deterministic modelling predicts that there will not be sufficient surface hydrocarbons for surface dispersant operations to be effective from day 1 onward, the resources currently available provide the capacity to treat 9-18 m^3 per day of surface oil from day 5, with 70-139 m^3 per week from Day 14 onwards.
- Arrangements for support organisations who provide specialist services (dispersant spray aircraft, logistics services for mobilising dispersant and Air Attack Supervisors) or resources (dispersants and transfer pumping systems) need to be in place and should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- The duration of the Credible Scenario-01 spill may extend up to 77 days with response operations extending to 150 days (5 months) based on the predicted time to complete shoreline clean-up operations.
- Defined Zone of Application (ZoA) to reduce environmental consequences on subsea receptors.
- In addition, a number of assumptions are required to estimate the response need for Surface Dispersant Application. These assumptions have been described in the table below.

Table 5-7: Response planning assumptions – surface dispersant application

<table>
<tr><th colspan="3">Response Planning Assumptions</th></tr>
<tr><td>Safety considerations</td><td colspan="2">Surface dispersant operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include:
• hydrocarbon gas and/or liquid exposure
• high winds, waves and/or sea states
• high ambient temperatures.</td></tr>
<tr><td>Technique</td><td colspan="2">Predicted performance range[6]
(% of surface oil volume predicted to be treated by response technique)</td></tr>
<tr><td rowspan="3">Surface dispersant application (combined vessel and aircraft)</td><td>Lower</td><td>5.25% (1:25 DOR x 42% effectiveness x 50% encounter rate)</td></tr>
<tr><td>Upper</td><td>6.6% (1:20 DOR x 44% effectiveness x 75% encounter rate)</td></tr>
<tr><td colspan="2">The predicted performance range for surface dispersant application is based on;
• remaining surface oil available for surface dispersant application following weathering,
• monitor and evaluate operations observing surface oil at minimum BAOAC 4 (discontinuous true oil colour) or BAOAC 5 (continuous true oil colour),
• safe for deployment, within range of vessels and aircraft,
• dispersant to oil application at 1:20-1:25 (based on uniform surface oil 100 g/m^2 and 50 litres/hectare application rate) allows for 3-4 km^2 per aircraft per day,
• predicted dispersant effectiveness of 44% for contacted surface oil (within likely application timeframe, and
• spraying encounter rate of approximately 50-75% (50-25% of dispersant sprayed does not contact surface oil)</td></tr>
<tr><td>Physical properties</td><td colspan="2"><u>Surface Threshold</u>
• Lower – 50 g/m^2 (equates to 100g/m^2 with approx. 50% coverage and/or 200 g/m^2 with approx. 25% coverage)
– BAOAC 4 – Discontinuous true oil colour - lower threshold 50 g/m^2
• Optimum – 100 g/m^2 (equates to >100 g/m^2 with approx. 100% coverage and/or 200 g/m^2 with approx. 50% coverage)
– BAOAC 5 – Continuous true oil colour – lower threshold 200 g/m^2
<u>Viscosity</u>
• Optimum – <5,000 cSt at sea surface temperature
• Upper – 15,000 cSt at sea surface temperature</td></tr>
<tr><td>Dispersant Effectiveness</td><td colspan="2">Dispersant testing on Enfield crude indicates that average dispersant efficiency (%) for oil age will be;
• ~42% (0 hrs)
• ~44% (24 hrs)
• ~50% (96 hrs)
• ~54% (>240 hrs)
This data is based on a range of weathering results and five (5) National Plan OSCA approved an/or transitional dispersants that will be the selected dispersant used by Woodside.</td></tr>
</table>

[6] Performance ranges outlined above are indicative for response planning purposes. Where actual figures and concentrations exist based on deterministic modelling or laboratory results, these will be used for response and capability planning.

5.5.2 Environmental performance based on need

Table 5-8: Environmental performance – surface dispersant application

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors and increase the bioavailability of hydrocarbons for microbial breakdown.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
15	Aerial spraying	15.1	1 aircraft with minimum payload of 1,850 litre payload mobilised to site within 4 hours of activation. 1 additional aircraft mobilised to site within another 20 hours of activation. 4 additional aircraft mobilised to site within 48 hours of activation.	1, 3B, 3C, 4
		15.2	1 high capacity aircraft with minimum payload of 10m^3 available to spray on day 2.	
		15.3	FWADC to complete a minimum of 2 sorties per day and high capacity aircraft to complete a minimum of 2 sorties per day	1
		15.4	Per sortie spray log completed to record where dispersants were applied	1, 3A, 3B
16	Vessel spraying	16.1	2 offtake support vessels from integrated fleet will undertake dispersant trials within 48 hours of the release as per first strike plan.	1, 3A, 3B, 3C, 4
		16.2	2 offtake support vessels will be available for deployment to spray dispersant for the duration of the response.	3A, 3C, 4
		16.3	Up to 4 vessels spraying per day by day 5	1, 3C
		16.4	Per day spray log completed to record where dispersants were applied	1, 3A, 3B
	Dispersant	17.1	Year-round access to 5,000m^3 of dispersant located globally which is ready to be mobilised on activation of GDS membership within 24-48 hours.	1, 3A, 3B, 3C, 3D, 4
		17.2	Year-round access to additional dispersant stockpiles via memberships with OSRL and AMOSC.	
		17.3	OSCA approved dispersants prioritised for surface and subsea use	1, 3A, 3B, 3C, 4
		17.4	Only apply surface dispersants within the ZoA and on BAOAC 4 and 5	
		17.5	Continuous monitoring of dispersed oil plume and visual monitoring of effectiveness	

The resulting surface dispersant response capability following ALARP evaluation has been assessed against the WCCS.

- Surface concentration and mass vary for each time step based on spreading and weathering algorithms within the model. Woodside has reviewed the deterministic modelling data based on the response planning assumptions outlined above to determine the response need and required capability.
- Deterministic modelling conducted for the loss of well control scenario predicts that, for the duration of the spill, surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for surface dispersant application operations to be effective.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.5.

5.6 Containment and recovery

Containment and recover is used to reduce damage to sensitive resources by the physical containment and mechanical removal of hydrocarbons from the marine environment. It has a lower capacity for removing surface oil than the application of dispersant but avoids potential additional impacts created by the resulting increase in entrained hydrocarbons in the water column.

Weathering and spreading of hydrocarbons will significantly reduce containment and recovery effectiveness. Containment and recovery is also weather and sea–state dependent. Periods of downtime can be expected and inability to use this technique during unfavourable weather conditions.

The conditions in the Exmouth region are expected to exceed wind speeds equivalent to Beaufort Sea-state 3 for approximately 90% of the year during the PAP (APASA modelling input data). Therefore, it is expected that open water containment and recovery operations would not, in general, be a feasible response strategy. It does, however, provide an alternative to dispersant application when calm conditions preclude effective dispersion and drift rates can be expected to be low. It is the only open water response strategy available for deployment inside the Ningaloo WHA and priority would be given to being prepared to deploy units if the conditions stated in below are met.

The *Containment and Recovery Operational Plan* details the mobilisation and resource requirements for response operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

5.6.1 Response need based on predicted consequence parameters

Deterministic modelling conducted for the Credible Scenario-01 loss of well control scenario predicts that, for the duration of the spill, surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for containment and recovery operations to be effective. As a conservative approach, Woodside has included containment and recovery as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed. Due to the lack of supporting results from the modelling, containment and recovery is not intended as a primary response technique. Although the deterministic modelling predicts that there will not be sufficient surface hydrocarbons for containment and recovery operations to be effective from day 1 onward, the resources currently available provide the capacity to recover 1-31 m^3 per day of surface oil from day 5, with 7-171 m^3 per week from Day 14 onwards.

- Arrangements for support organisations who provide specialist services (logistics services for mobilising equipment, trained Offshore Supervisors and waste disposal) and/or resources (vessels, containment and recovery equipment, transfer pumping systems) should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for Containment and Recovery. These assumptions have been described in the table below.

Table 5-9: Response planning assumptions – containment and recovery

<table>
<tr><th colspan="3">Response Planning Assumptions</th></tr>
<tr><td>Safety considerations</td><td colspan="2">Containment and recovery 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.</td></tr>
<tr><td>Technique</td><td colspan="2">Predicted performance range
(% of surface oil volume available predicted to be recovered by response technique)</td></tr>
<tr><td rowspan="3">Containment and recovery</td><td>Lower</td><td>5%</td></tr>
<tr><td>Upper</td><td>10%</td></tr>
<tr><td colspan="2">The predicted performance range for containment and recovery is based on;
• remaining surface oil available for containment and recovery following weathering,
• monitor and evaluate operations observing surface oil at minimum BAOAC 4 (discontinuous true oil colour) or BAOAC 5 (continuous true oil colour)
• encounter rate of approximately 50-75% (50-25% of surface coverage is not surface oil)</td></tr>
<tr><td colspan="3">Response Capability details</td></tr>
<tr><td>Containment and recovery operation</td><td colspan="2">• 1 x containment and recovery operation includes;
– 2 x suitable vessels (vessel specifications as per Marine Operations Plan)
– 1 x boom system (min 800 mm overall height and approx. 200 m length) with all required ancillaries)
or
– 1 x suitable vessel (vessel specifications as per Marine Operations Plan)
– 1 x single ship system (min 800 mm overall height and approx. 200 m length) with all required ancillaries)
and
– 1 x skimmer (min 20 m3 / hr) with all required ancillaries
– 1-2 x trained supervisor per operation
– 8-10 x support personnel per operation</td></tr>
<tr><td>Physical properties</td><td colspan="2"><u>Surface Threshold</u>
• Lower – 50 g/m^2 (equates to 100 g/m^2 with approx. 50% coverage and/or 200 g/m^2 with approx. 25% coverage)
– BAOAC 4 – Discontinuous true oil colour - lower threshold 50 g/m^2
• Optimum – 100 g/m^2 (equates to >100 g/m^2 with approx. 100% coverage and/or 200 g/m^2 with approx. 50% coverage)
– BAOAC 5 – Continuous true oil colour – lower threshold 200 g/m^2</td></tr>
<tr><td>Expected effectiveness</td><td colspan="2">• 1 x containment and recovery operation is expected to be able to contain and recover approx. 22.5 – 67.5 m^3 per day (10hr operation) includes one (1) change out of temporary waste storage equipment (if required)
• Based on the following assumptions;
– Boom system with 70 m opening = 0.07 km
– Vessel moving at 0.7 kn = 1.3 km/h
– Area covered per hour = 0.07 km x 1.3 km = 0.09 km^2
– Area covered per day = 0.09 km^2 x 10 hours = 0.9 km^2 / day
– Recovery per day (low) = 0.9 km^2 x 50 g/m^2 x 50% coverage = 22.5 m^3 / 10-hour day
– Recovery per day (high) = 0.9 km^2 x 100 g/m^2 x 75% = 67.5 m^3 / 10-hour day
Increased surface oil concentration may result in increased recovery capacity providing other conditions and oil properties remain suitable for containment and recovery. For planning purposes, conservative concentrations outlined above have been used.</td></tr>
</table>

5.6.2 Environmental performance based on need

Table 5-10: Environmental performance – containment and recovery

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
18	Vessel-based recovery systems	18.1	Woodside maintains an integrated fleet of vessels, including vessels with at least 10t bollard pull. Additional vessels can be sourced through existing contracts/frame agreements	1, 3A, 3B, 3C, 4
		18.2	2 containment and recovery operations would be deployed by day 2.	
		18.3	4 additional containment and recovery operations using 3rd party provider resources would be deployed by day 10.	
		18.4	Each operation will have internal or added 100 m^3 of liquid waste storage onboard.	
19	Response teams	19.1	Deployment of 2 containment and recovery teams would be available by day 2 and 4 containment and recovery teams available by day 5.	1, 2, 3A, 3B, 3C, 4
		19.2	Deployment team will be comprised of: • 1-2 trained specialists per operation • 8-10 personnel for support • Personnel sourced through resource pool	1, 2, 3B, 4
		19.3	Teams will segregate liquid and solid wastes at the earliest opportunity.	
		19.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s)	1, 3A, 3B
20	Response systems	20.1	Rapid sweep systems and active boom systems to be prioritised for mobilisation in the event of a response.	1, 3C
21	Management of Environmental Impact of the response risks	21.1	The boom will be monitored and maintained to ensure trapped fauna are released as early as possible, with Containment and Recovery activities occurring in daylight hours only.	1
		21.2	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified	

Woodside has assessed the resulting containment and recovery capability against the WCCS.

- Surface concentration and mass vary for each time step based on spreading and weathering algorithms within the model. Woodside has reviewed the deterministic modelling data based on the response planning assumptions outlined above to determine the Response Need and required capability.
- Deterministic modelling conducted for the loss of well control scenario predicts that, for the duration of the spill, surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for containment and recovery operations to be effective.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.6.

5.7 Shoreline 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 are safe to deploy protection and deflection measures,
- oil trajectory has been identified as heading towards identified RPAs.

5.7.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which the response need can be based:

- The shortest timeframe that shoreline contact from floating oil above threshold is predicted to be 0.9 days at Ningaloo Coast North WHA (19 m^3) for Credible Scenario-06, 2.25 days at Ningaloo Coast North (0.389 m^3) for Credible Scenario-05 and 21 days at Mangrove Bay (0.882 m^3) and Jurabi-Lighthouse Beaches within 40.5 days (410 m^3) for Credible Scenario-01. No shoreline impact is predicted for Credible Scenario-03.
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact, which occurs on 0.9 days at Ningaloo Coast North WHA (19 m^3) for Credible Scenario-06, day 2.25 at Ningaloo Coast North (0.389 m^3) for Credible Scenario-05 and 21 at Mangrove Bay (0.882 m^3) for Credible Scenario-01
- Due to potentially high levels of volatiles from a spill of marine diesel, shoreline protection and deflection, pre-emptive assessments and shoreline assessments would only be undertaken if safety of responders could be ensured.
- The duration of the Credible Scenario-01 and Credible Scenario-03 spills may be up to 77 days with shoreline response operations extending to 150 days (5 months) based on the predicted time to complete shoreline clean-up operations.
- No shoreline impact is predicted for Credible Scenario-03, however, for 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) to direct any protection and deflection operations.
- 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 and should be tested regularly.
- TRPs for RPAs with other relevant plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for Shoreline Protection and Deflection. These assumptions have been described in the table below.

Table 5-11: Response planning assumptions – shoreline protection and deflection

Response Planning Assumptions	
Safety considerations	Shoreline protection and deflection operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • safe for deployment and conditions within range of vessels • high ambient temperatures.
Shoreline protection and deflection	• 1 x shoreline protection and deflection operation may include; – Quantity of shoreline sealing boom (as outlined in TRP) – Quantity of fence or curtain boom (as outlined in TRP) – 1-2 x trained supervisors – 8-10 x personnel / labour hire Specific details of each operation would be tailored to the TRP implemented (where available).

5.7.2 Environmental performance based on need

Table 5-12: Environmental performance – shoreline protection and deflection

Environmental Performance Outcome		To stop hydrocarbons encountering particularly sensitive areas		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
22	Response teams	22.1	In liaison with WA DoT (for Level 2/3 incidents), relevant TRPs will be identified in the first strike plan for activation within 12 hours of the release.	1, 3A, 3C, 4
		22.2	In liaison with WA DoT (for Level 2/3 incidents), mobilise teams to RPAs within 12 hours of operational monitoring predicting impacts. Teams to contaminated RPAs comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire • Personnel sourced through resource pool	1, 2, 3B, 3C, 4
		22.3	In liaison with WA DoT (for Level 2/3 incidents), 1 operation deployed within 24 hours of operational monitoring predicting impacts to each identified RPA. Expected to be 4 RPAs within 4 days (operation as detailed above).	1, 3A, 3B, 4
		22.4	Up to 30 trained supervisors (plus additional labour personnel) able to form up to 15 teams available within 48 hours sourced through resource pool.	1, 2, 3A, 3B, 3C, 4
		22.5	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s)	1, 3A, 3B
		22.6	The safety of shoreline response operations will be considered and appropriately managed. During shoreline operations: • All personnel in a response will receive an operational/safety briefing before commencing operations • Gas monitoring and site entry protocols will be used to assess safety of an operational area before allowing access to response personnel	1, 3B, 4
23	Response equipment	23.1	Equipment mobilised from closest stockpile within 12 hours.	1, 3A, 3C, 4
		23.2	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 24 hours.	1, 3C, 3D, 4
		23.3	Supplementary equipment mobilised from OSRL within 48 hours.	
		23.4	Woodside maintains integrated fleet of vessels. Additional vessels can be sourced through existing contracts/frame agreements	1, 3A, 3C, 4
24	Management of Environmental Impact of the response risks	24.1	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified	1
		24.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines	

The resulting shoreline protection and deflection capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to shoreline protection and deflection at identified RPAs.

Under optimal conditions, during the subsea and surface releases, the capability available exceeds the need identified. It indicates that, the shoreline protection and deflection capability has the following expected performance:

- Deterministic modelling scenarios indicate that first shoreline impact at 0.9 days at Ningaloo Coast North WHA (Credible Scenario-06), Ningaloo Coast North on day 2.25 (Credible Scenario-05) and Mangrove Bay within 21 days (Credible Scenario-01).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact.
- Woodside has the capacity to mobilise and deploy 1 protection and deflection operation (approximately 10-12 responders) within 24 hours. Woodside would deploy Burrup Field Responder personnel (up to 30 trained supervisors) to undertake further operations by day 2 (if VOC levels permit). These trained personnel would provide up to 15 additional teams i.e. 2 supervisors plus 8-10 general contracted workforce per team. These personnel are in addition to existing contracts with AMOSC, Core Group, AMSA, WA DoT and OSRL. This would be only executed in agreement with WA DoT.
- The control measures selected provide capability to mobilise protection and deflection operations within 24 hours with additional resources from existing labour contracts mobilised from day 2 which meets the need.
- The most significant constraint on expanding the scale of response operations is the availability of accommodation and transport services in the region between Exmouth and Port Hedland, and the 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 all identified RPAs excepting 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 6.8

5.8 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, and 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.

The *Shoreline Cleanup Operational Plan* 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).

5.8.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which the response need can be based:

- The shortest timeframe that shoreline contact from floating oil above threshold is predicted to be 0.9 days at Ningaloo Coast North WHA (19 m^3) for Credible Scenario-06, 2.25 days at Ningaloo Coast North (0.389 m^3) for Credible Scenario-05 and, for Credible Scenario-01, 21 days at Mangrove Bay (0.882 m^3) with shoreline accumulation peaking at approximately 410 m^3 on day 40.5 (Month 2) at Jurabi-Lighthouse beaches and 514 m^3 on day 81.5 (Month 3) at Barrow and Lowendal Islands. No shoreline impact is predicted for Credible Scenario-03.
- Due to potentially high levels of volatiles from a spill of marine diesel, shoreline assessments and would only be undertaken if safety of responders could be ensured.
- The duration of the Credible Scenario-01 and Credible Scenario-03 spills may be up to 77 days with response operations extending up to day 150 (Month 5) based on the predicted time to complete shoreline clean-up operations.
- No shoreline impact is predicted for Credible Scenario-03, however, for 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.
- Following Shoreline Assessment and agreement of prioritisation with WA DoT (if a Level 2/3 incident), clean-up operations would commence until agreed termination criteria are reached.
- 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 need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- The above volumes assume no treatment via other response techniques prior to contact so are considered very conservative.

In addition, a number of assumptions are required to estimate the response need for shoreline clean-up. These assumptions have been described in the table below.

Table 5-13: Response planning assumptions – shoreline clean-up

Response planning assumptions: Shoreline clean-up	
Safety considerations	Shoreline clean-up operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • waves and/or sea states, tidal cycle and intertidal zone limits • presence of wildlife • high ambient temperatures.
Manual shoreline clean-up operation (Phase 2)	1 x manual shoreline clean-up operation (Phase 2) may include: • 1–2 x trained supervisor • 8–10 x personnel/labour hire • Supporting equipment for manual clean-up including rakes, shovels, plastic bags etc.
Physical properties	**Surface Threshold for Response Planning** • 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^2–1000 g/m^2) with manual removal using shovels/rakes, etc. from studies of previous response operations and exercises

Table 5-14: Shoreline clean-up techniques and recommendations

Technique	Description	Shoreline type: Recommended	Shoreline type: Not recommended	Application
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).

Technique	Description	Shoreline type: Recommended	Shoreline type: Not recommended	Application
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.
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.

Technique	Description	Shoreline type: Recommended	Shoreline type: Not recommended	Application
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 (OSCA)	Application of chemicals such as dispersants to remove hydrocarbons.	May be used for manmade structures and where public safety may be a concern.	Natural substrates and in low-energy environments where sufficient mixing energy is not present.	Not recommended for shorelines. Could be used for manmade structures such as boat ramps.

5.8.2 Environmental performance based on need

Table 5-15: Environmental performance – shoreline clean-up

Environmental Performance Outcome		To remove bulk and stranded hydrocarbons from shorelines and facilitate shoreline amenity habitat recovery.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.13)**
25	Shoreline responders	25.1	In liaison with WA DoT (for Level 2/3 incidents), deployment of 1 shoreline clean-up team to each contaminated RPA comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire. • Personnel sourced through resource pool upon request from the IMT.	1, 2, 3A, 3B, 3C, 4
		25.2	Relevant TRPs will be identified in the first strike plan for activation within 12 hours.	1, 3A, 3C, 4
		25.3	Relevant TRPs created for shorelines at risk of accumulations within 48 hours of operational monitoring predicting impacts.	1, 3A, 3C, 4
		25.4	Clean-up operations for shorelines in line with results and recommendations from SCAT outputs	1, 3A, 3B
		25.5	All shoreline clean-up sites will be zoned and marked before clean-up operations commence	
		25.6	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy up to 1 shoreline clean-up operations within 24 hours.	1, 2, 3A, 3C, 4
		25.7	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy up to 30 trained supervisors (plus additional labour personnel) able to form up to 15 teams within 48 hours, sourced through resource pool.	
		25.8	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy up to 1 shoreline clean-up operations where operational monitoring predicts accumulations within 24 hours.	1, 2, 3A, 3C, 4
		25.9	The safety of shoreline response operations will be considered and appropriately managed. During shoreline clean-up operations: • All personnel in a response will receive an operational/safety briefing before commencing operations • Gas monitoring and site entry protocols will be used to assess safety of an operational area before allowing access to response personnel	1, 3B, 4
		25.10	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s)	1, 3A, 3B
26	Shoreline clean up equipment	26.1	Contract in place with 3rd party providers to access equipment.	1, 3A, 3C, 4
		26.2	Equipment mobilised from closest stockpile within 12 hours.	
		26.3	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 24 hours.	1, 3C, 3D, 4
		26.4	Supplementary equipment mobilised from OSRL within 48 hours.	
27	Management of Environmental Impact of the response risks	27.1	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
		27.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines	
		27.3	Vehicular access will be restricted on dunes, turtle nesting beaches an in mangroves	

		27.4	Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations.	
		27.5	Removal of vegetation will be limited to moderately or heavily oiled vegetation	
		27.6	Oversight by trained personnel who are aware of the risks	
		27.7	Trained unit leader's brief personnel of the risks prior to operations	

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.

Whilst modelling predicts shoreline contact from day 0.9 at Ningaloo Coast North WHA (Credible Scenario-06), day 2.25 at Ningaloo Coast North (Credible Scenario-05) and day 21 at Mangrove Bay (Credible Scenario-01), Woodside is satisfied that the capability stated below is managing risks and impacts to ALARP.

The shoreline clean-up capability has the following expected performance (if required during a response):

- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact.
- Woodside has the capacity to mobilise and deploy 1 shoreline clean-up team (approximately 10-12 responders) within 24 hours. Due to the short impact timeframe for Credible Scenario-05 and Credible Scenario-06, Woodside would deploy Burrup Field Responder personnel (up to 30 trained supervisors) to undertake shoreline and nearshore operations from Exmouth by day 2 (if VOC levels permit). These trained personnel could undertake SCAT, protection and deflection or Shoreline Clean-up operations and would provide up to 15 additional teams i.e. 2 supervisors plus 8-10 general contracted workforce per team. These personnel are in addition to existing contracts with AMOSC, Core Group, AMSA, WA DoT and OSRL. This would be only executed in agreement with WA DoT.
- Following Shoreline Assessment and agreement of prioritisation with WA Department of Transport, clean-up operations would commence until agreed termination criteria are reached.
- The control measures selected provide capability to mobilise shoreline clean-up equipment by within 24 hours with additional resources from existing labour contracts mobilised from day 2. The shoreline clean-up capability would be sufficient by day 3, by which point it is also expected that the majority of VOCs would have dissipated providing a safe environment for responders, although VOCs will be constantly monitored to ensure the continued safety of responders.
- The most significant constraint on expanding the scale of response operations is the availability of accommodation and transport services in the region between Exmouth and Port Hedland, and the 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 all identified RPAs excepting 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 6.8

5.9 Waste management

Waste management is considered a support technique to wildlife response, containment and recovery and shoreline clean-up. Waste generated and collected during the response that will require handling, management and disposal may consist of:

- Liquids (hydrocarbons and contaminated liquids) collected during wildlife response, containment and recovery and shoreline clean-up, and/or
- Solids/semi-solids (oily solids, garbage, contaminated materials) and debris (e.g. seaweed, sand, woods, and plastics) collected during wildlife response, containment and recovery and shoreline clean-up.

Expected waste volumes during an event are likely to vary depending on oil type, volume released, response techniques employed and how weathering of hydrocarbons. Waste management, handling and capacity should be scalable to ensure continuous response operations can be maintained.

All waste management activities will follow the Environment Protection (Controlled Waste) Regulations 2004 and the waste will be managed to minimise final disposal volumes. Waste treatment techniques will consider contaminated solids treatment to allow disposal to landfill and solids with high concentrations of hydrocarbon will be treated and recycled where possible or used in clean fill if suitable.

The waste products would be transported from response locations to the nearest suitable staging area/waste transfer station for treatment, disposal or recycling. Waste will be transferred with appropriately licensed vehicles. Containers will be available for temporary waste storage and will be:

- labelled with the waste type
- provided with appropriate lids to prevent waste being blown overboard
- bunded if storing liquid wastes.
- processes will be in place for transfers of bulk liquid wastes and include:
  - inspection of transfer hose undertaken prior to transfer
  - watchman equipped with radio visually monitors loading hose during transfer
  - tank gauges monitored throughout operation to prevent overflow

The *Oil Spill Preparedness Waste Management Support Plan* details the procedures, capability and capacity in place between Woodside and its primary waste services contractor (Veolia Waste Management) to manage waste volumes generated from response activities.

5.9.1 Response need based on predicted consequence parameters

Table 5-16: Response planning assumptions – waste management

	Response planning assumptions: Waste management
Waste loading per m^3 oil recovered (multiplier)	Containment & Recovery – approx. 10x multiplier for oily waste generated by containment and recovery operations
	Shoreline clean-up (manual) – approx. 5-10x multiplier for oily solid and liquid wastes generated by manual clean-up
	Oiled wildlife response – approx. 1m^3 of oily liquid waste generated for each wildlife unit cleaned

5.9.2 Environmental performance based on need

Table 5-17: 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 5.13)**
28	Waste Management	28.1	Contract with waste management services for transport, removal, treatment and disposal of waste	1, 3A, 3B, 3C, 4
		28.2	Access to at least 0-200 m^3 of solid and liquid waste storage available by day 2 and access to an additional 100-500 m^3 by day 3 upon activation of 3rd party contract.	
		28.3	Access to up to 120,000 m^3 waste via 3rd party contract	
		28.4	Decanting in accordance with National Plan guidelines to occur in daylight hours into the apex of the boom once hydrocarbon/water has settled in storage container.	
		28.5	Recovered hydrocarbons and wastes will be transferred to licensed treatment facility for reprocessing or disposal.	
		28.6	Teams will segregate liquid and solid wastes at the earliest opportunity.	
		28.7	Waste management provider support staff available year-round to assist in the event of an incident with waste management as detailed in contract.	
		28.8	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
		28.9	Waste management to be conducted in accordance with Australian laws and regulations	1, 3A, 3B, 3C, 4
		28.10	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.

The largest shoreline volumes ashore are predicted to be 139 m^3 on day 2 (Credible Scenario-06), 197 m^3 on day 3 (Credible Scenario-05) and 889.935 m^3 during month 3 (Credible Scenario-01). Across all shoreline clean-up operations for each scenario, 245 m^3 to 1225 m^3 would be expected for Credible Scenario-06, 785 m^3 to 3984 m^3 of waste would be expected for Credible Scenario-05 and 2008 m^3 to 10,038 m^3 would be expected for Credible Scenario-01. The capability available exceeds the need identified by day 5.

It indicates that the waste management capability has the following expected performance:

- Offshore operations may generate up to an additional peak of 519 m^3 oily waste for one week.
- Shoreline and nearshore operations may generate up to 2008 m^3 to 10,038 m^3 oily waste over 5 months of operations.
- Wildlife response is estimated to produce an additional 10 m^3 of waste per day per operation.
- Veolia's total waste handling volume is 120,000 m^3. The waste management requirements are thus within Woodside's and its service providers existing capacity.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.9.

5.10 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 Biodiversity, 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. Additional personnel would be sourced through Woodside’s arrangements to support an oiled wildlife response as required.

5.10.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- Modelling predicts the shortest time to shoreline contact on day 0.9 at Ningaloo Coast North WHA (Credible Scenario-06), day 2.25 at Ningaloo Coast North (Credible Scenario-05) and day 21 at Mangrove Bay (Credible Scenario-01). No shoreline impact is predicted for Credible Scenario-03.
- The offshore location of the release site is expected to initially result in low numbers of at-risk or impacted wildlife.
- As the surface oil approaches shorelines, potential for oiled wildlife impacts are likely to increase.
- It is estimated that an oiled wildlife response would be between Level 2 and 3, as defined in the WA OWRP.

Table 5-18: Key at-risk species potentially in response protection areas and open ocean

Species	Open Ocean	Ningaloo Coast	Rankin Bank	Shark Bay	Montebello and Barrow Islands
Marine turtles	✓	✓	✓	✓	✓
Sea birds and/or migratory shorebirds	✓	✓		✓	✓
Cetaceans – migratory whales	✓	✓		✓	✓
Cetaceans – dolphins and porpoises	✓	✓	✓	✓	✓
Dugongs		✓		✓	✓
Whale sharks	✓	✓	✓		✓
Sea snakes	✓	✓	✓	✓	✓

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 5-19 below.

Table 5-19: 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 Exmouth have been identified in the draft Regional OWROP, should a land-based site be required.
Stage 7: Wildlife rehabilitation	Considerations include a suitable rehabilitation centre and personnel, wildlife housing, record keeping and success tracking.
Stage 8: Oiled wildlife response termination	Once a decision has been made to terminate operations, the Incident Controller will stand down individual participating and supporting agencies.

Reconnaissance and primary response would be done during operational monitoring and surveillance activities. Where marine wildlife are observed on water or transiting near or within the spill area, observations would be recorded through surveillance records. The shoreline assessments would be done in accordance with OM05, which would be used as a further tool to identify wildlife and habitats contacted by hydrocarbons.

Staging sites would be established as forward bases for shoreline- or vessel-based field teams. Once recovered to a staging site, wildlife would be transported to the designated oiled wildlife facility or a temporary holding centre (before being transported to the oiled wildlife facility). Temporary holding centres are required when there is significant distance between a staging site and the oiled wildlife facility, to enable stabilisation of oiled animals. The oiled wildlife facility is the primary location where animals would be housed and treated. Sites proposed for staging a regional oiled wildlife response in 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 5-20) and the resources likely to be needed at each increasing level of response.

Table 5-20: Indicative oiled wildlife response level (adapted from the WA OWRP, 2014)

OWR 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	None	None	None	None	None
Level 2	26	> 4–14 days	1–5/day < 20 total	None	< 20 hatchlings No juv/adults	None	None	None
Level 3	59	> 4–14 days	5–10/day	1–5/day < 10 total	< 5 juv/adults < 50 hatchlings	None	< 5	None
Level 4	77	> 4–14 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	> 4–14 days	10–100/day > 200 total	10–50/day	> 20 juv/adults > 500 hatchlings	< 5 dolphins	> 50	Dugongs oiled
Level 6	122	> 4–14 days	> 100/day	10–50/day	> 20 juv/adults > 500 hatchlings	> 5 dolphins	> 50	Dugongs oiled

5.10.2 Environmental performance based on need

Table 5-21: 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 5.13)**
29	Wildlife response equipment	29.1	Contracted capability to treat 100 individual wildlife for immediate mobilisation to Response Priority Areas (RPAs)	1, 3A, 3B, 3C, 4
		29.2	Contracted capability to treat up to an additional 250 individual wildlife within a five-day period.	
		29.3	National plan access to additional resources under the guidance of WA DoT (up to a Level 5 oiled wildlife response as specified in the OWRP), with the ability to treat about 600 individual wildlife by the time hydrocarbons contact the shoreline.	1, 3C, 4
		29.4	Vessels used in hazing/pre-emptive capture will approach wildlife at slow speeds to ensure animals are not directed towards the hydrocarbons.	1, 3A, 3B, 4
		29.5	Facilities for the rehabilitation of oiled wildlife are operational 24/7 as per WAOWRP.	1, 3A, 4
30	Wildlife responders	30.1	4 wildlife divisional commanders to lead the oiled wildlife operations who have completed an Oiled Wildlife Response Management course	1, 2, 3B
		30.2	Wildlife responders to be accessed through resource pool and additional agreements with specialist providers	1, 2, 3A, 3B, 3C, 4
		30.3	Oiled wildlife operations (including hazing) would be implemented with advice and assistance from the Oiled Wildlife Advisor from the DBCA.	1
		30.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s)	1, 3A, 3B

The resulting wildlife response capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to response at identified RPAs.

Under optimal conditions, during the subsea or surface release the capability available meets the need identified. It indicates that, the wildlife response capability has the following expected performance:

- Mobilisation and deployment of approximately 1 wildlife collection teams by day 2 at Ningaloo Coast North (Credible Scenario-05 and Credible Scenario-06).
- Mobilisation and deployment of approximately 1 additional wildlife collection teams by day 4 at Ningaloo Coast Middle (Credible Scenario-05) and at Ningaloo RPAs (Yardie Creek, Turquoise Bay, Jurabi-Lighthouse Beaches) by day 21.
- Mobilisation and deployment of approximately 2 wildlife collection teams by month 2 at Montebello/Barrow Islands.
- Mobilisation and deployment of approximately 2 wildlife collection teams at 2 Gascoyne RPAs (Shark Bay, Abrolhos Islands – NEBA determines environmental benefit).
- Mobilisation and deployment of approximately 1 wildlife collection teams at 1 Dampier RPAs (Southern Pilbara Islands – NEBA determines environmental benefit).
- Mobilisation and deployment of 2 central wildlife treatment and rehabilitation locations at Exmouth and Dampier in accordance with WA OWRP.

Wildlife collection operations would be expected to be completed by month 3 based on continuing shoreline impacts predicted. Additional capability could be deployed but given modelling predicts ongoing impacts in month 2 and 3, additional personnel are unlikely to increase the net environmental benefit and this capability is considered to be a manageable balance between effectiveness and minimising environmental impact.

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 Exmouth.

5.11 Scientific monitoring

A scientific monitoring program (SMP) would be activated following a Level two or three unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. This would consider receptors at risk (ecological and socio-economic) for the entire predicted Environment that Maybe Affected (EMBA) and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the credible spill scenario(s) or other identified unplanned hydrocarbon releases associated with the operational activities (refer to Table 2-1: PAP credible spill scenarios).

The outputs of the stochastic hydrocarbon spill modelling were used to assess the environmental risk of the hydrocarbon affected area as delineated by the ecological impact EMBA and social-cultural EMBA based on exceedance of environmental and social-cultural hydrocarbon threshold concentrations (refer to Table 2-2, Section 2.3.1.1 and see Section 4 and 7 of the EP for further information on applicable thresholds and the EMBAs). The PAP worst-case credible spill Credible Scenario-01 and Credible Scenario-05 define the EMBAs and are the basis of the SMP approach presented in this section

It should be noted that the resulting SMP receptor locations differ from the Response Protection Areas (RPAs) presented and discussed in Section 3 of this document due to the applicability of different hydrocarbon threshold levels. The SMP would be informed by the data collected via the operational monitoring program (OMP) studies, however, it differs from the OMP in being a long-term program independent of, and not directing, the operational oil spill response or monitoring of impacts from response activities (refer to Section 5.1) for operational monitoring overview).

Key objectives of the Woodside oil spill SMP are:

- Assess the extent, severity and persistence of the environmental impacts from the spill event; and
- Monitor subsequent recovery of impacted key species, habitats and ecosystems.

The SMP comprises ten targeted environmental monitoring programs to assess the condition of a range of physico-chemical (water and sediment) and biological (species and habitats) receptors including EPBC Act 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 NOPSEMA Bulletin #1 Oil Spill Modelling (2019), as shown in Figure 5-1.

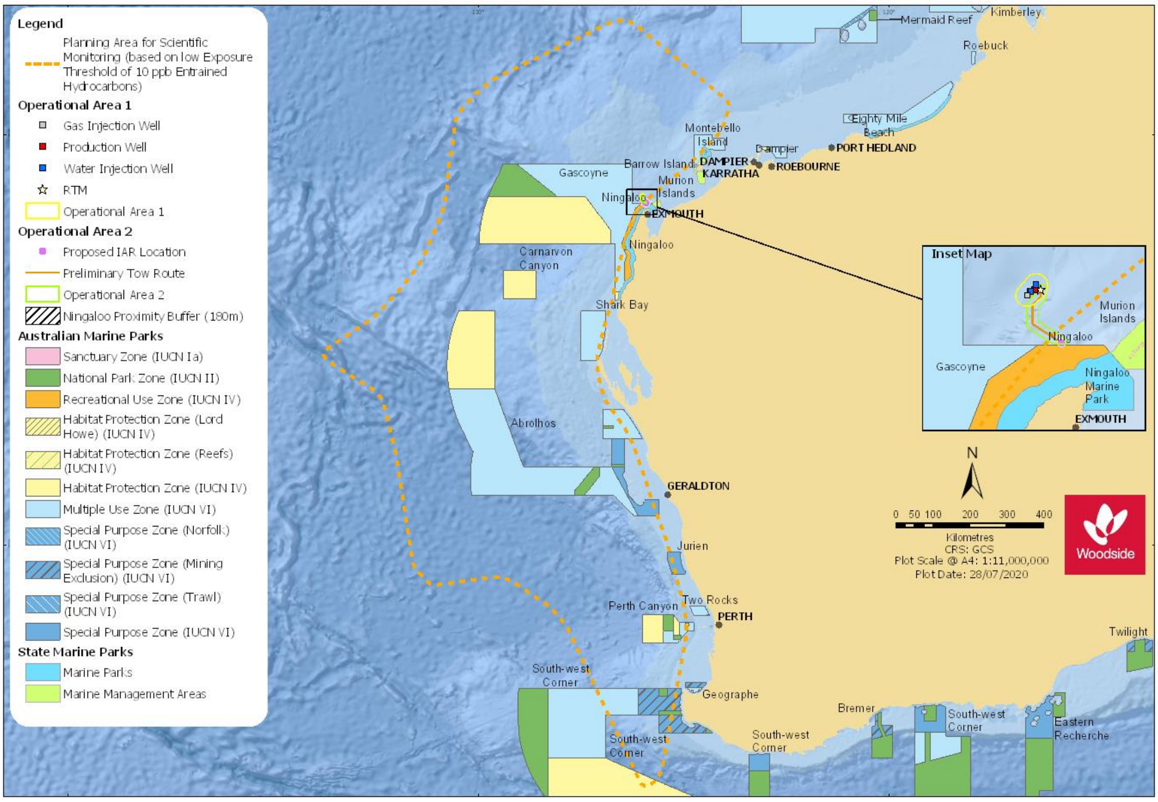

Figure 5-1: The planning area for scientific monitoring based on the area potentially contacted by the low (below ecological impact) entrained hydrocarbon threshold of 10 ppb in the event of the worst-case credible spill scenario (Credible Scenario-01).

Please note that Figure 5-1 represents the overall combined extent of the oil spill model outputs based on a total of 100 replicate simulations over an annual period for Credible Scenario-01 and therefore represents the largest spatial boundaries of 100 Credible Scenario-01 oil spill combinations, not the spatial extent of a single Credible Scenario-01 spill.

5.11.1 Scientific monitoring deployment considerations

Table 5-22: Scientific monitoring deployment considerations

Scientific Monitoring Deployment Considerations	
Existing baseline studies for sensitive receptor locations predicted to be affected by a spill	PBAs of the following two categories: • PBAs within the predicted <10-day hydrocarbon contact time prediction: The approach is to conduct a desktop review of available and appropriate baseline data for key receptors for locations (if any) that are potentially impacted within 10 days of a spill and look to conduct baseline data collection to address data gaps and demonstrate spill response preparedness. Planning for baseline data acquisition is typically commenced pre-PAP and execution of studies undertaken with consideration of weather, receptor type, seasonality and temporal assessment requirements. • PBAs >10 days' time to predicted hydrocarbon contact in the event of an unplanned hydrocarbon release (from the facility operational activities). SMP activation (as per the Nganhurra Cessation of 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.

5.11.2 Response planning assumptions

Table 5-23: Scientific monitoring response planning assumptions

Response Planning Assumptions	
PBAs	PBAs identified through the application of defined hydrocarbon impact thresholds during the Quantitative Spill Risk Assessment process and a consideration of the minimum time to contact at receptor locations fall into two categories: • PBAs for which baseline data are planned for and data collection may commence pre-PAP (≤ 10 days minimum time to contact), where identified as a gap. • PBAs (> 10 days minimum time to contact) for which baseline data may be collected in the event of an unplanned hydrocarbon release. Response phase PBAs are prioritised for SMP activities due to vulnerability (i.e. time to contact and environmental sensitivity) to potential impacts from hydrocarbon contact and an identified need to acquire baseline data. Time to hydrocarbon contact of >10 days has been identified as a minimum timeframe within which it is feasible to plan and mobilise applicable SMPs and commence collection of baseline (pre-hydrocarbon contact) data, in the event of an unplanned hydrocarbon release from Nganhurra Cessation of Operations. PBAs for Nganhurra Cessation of Operations are 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: • Ningaloo Coast, north and Middle [7] For example, adequate baseline data are available for Ningaloo was last surveyed (benthic communities and fish assemblages) in November/December 2014 (AIMS, 2015). Australian Marine Parks (AMPs) potentially affected includes: • Ningaloo AMP • Gascoyne AMP All the Australian Marine Parks (AMPs) are located in offshore waters where hydrocarbon exposure is possible on surface waters and in the water column.
In the Event of a Spill	Locations with >10 days to hydrocarbon contact, as well as the wider area, will be investigated and identified by the SMP team (in the Environment Unit of the Incident Control Centre (ICC)) as the spill event unfolds and as the situational awareness provided by the OMPs permits delineation of the spill affected area (for example, updates to the spill trajectory tracking). The full list is presented in ANNEX D, based on the PAP worst-case credible spill scenario(s) (Table 2-1). To address the initial focus in a response phase SMP planning situation, receptor locations predicted to be contacted between >10 days and 20 days have been identified as follows: • Ningaloo Coast, south (Coral Bay to Red Bluff) [8] 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 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

[7] Ningaloo Coast includes the WHA and State Marine Park.

	hydrocarbon contact). With reference to the Nganhurra Cessation of Operations, priority would be focused on Ningaloo Coast, south (Coral Bay to Red Bluff)[7]. 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 iii. Collect baseline data for receptors predicted to be outside the spill affected area so reference datasets for comparative analysis with impacted receptor types can be assessed post-spill.
Baseline Data	A summary of the spill affected area and receptor locations as defined by the EMBAs for the PAP worst case credible spill Credible Scenario-01 and Credible Scenario-05, is presented in the Nganhurra Cessation of Operations EP (Section 7). 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 MEE 1 and 5. 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 IGEM (Industry-Government Environmental Metadata database) (refer to ANNEX C).

5.11.3 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.

5.11.4 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, south (Coral Bay to Red Bluff) [8]

Documented baseline studies are available for certain sensitive receptor locations including the Ningaloo Coast (ANNEX D, Table D-2). The SMP approach in the response phase would still deploy SMP teams to maximise the opportunity to collect pre-emptive baseline data at sensitive receptor locations, i.e., the sections of the Ningaloo Coast not immediately exposed 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 6.11 considers ways to reduce the gap by considering alternate, additional, and/or improved control measures on each selected response strategy.

5.11.5 Environmental performance based on need

Table 5-24: Environment Performance - Scientific Monitoring

Environmental Performance Outcome		Woodside can demonstrate preparedness to stand up the SMP to quantitatively assess and report on the extent, severity, persistence and recovery of sensitive receptors impacted from the spill event.		
Control measure		**Performance Standard**		**Measurement Criteria**
31	• Woodside has an established and dedicated SMP team comprising the Environmental Science Team and additional Environment Advisers within the Health Safety Environment and Quality (HSEQ) Function.	31.1	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.
32	• Woodside have 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.	32.1	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. SMP team stand up personnel receive training regarding the stand up, activation and implementation of the SMP on an annual basis.	• OSPU 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. • Training materials. • Training attendance registers. • Competency criteria for SMP roles. • SMP annual arrangement

				testing and reporting.
33	• 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 control 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 Information System (IMIS) 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 FSRP. • Step by step process to activation of individual SMPs provided in the SMP Operational Plan. • All decisions made regarding SMP logged in the online IMIS (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 IMIS. • Woodside Environmental Science Team provide 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 provide awareness training on the activation and stand-up of the Scientific Monitoring Programme (SMP) for the SMP Standby provider. • Woodside Environmental Science Team co-ordinates an annual SMP arrangement testing exercise which the Standby SMP contractor SMP team participates in since 2016 (report on 2016 SMP simulation: and Standby SMP contractor SMP arrangements (people and equipment availability) tested annually since 2016.	33.1	• Woodside have 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.

34	• 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 practicable, the environmental baseline data prior to hydrocarbon contact required to support the post-response SMP.	34.1	Woodside maintains standby SMP capability to mobilise equipment required to conduct scientific monitoring programs SM01 – SM10 (except desktop based SM08): • Equipment are sourced through the existing standby contract with Standby SMP standby contractor, as detailed within the SMP Implementation Plan.	• OSPU Internal 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.
35	• 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:	35.1	• Annual reviews of environmental baseline data. • PAP specific Pre-emptive Baseline Area baseline gap analysis.	• Annual review/update of Woodside Baseline Environmental Studies Database.

	• Documentation annual reviews of the Woodside Baseline Environmental Studies Database, and specific activity baseline gap analyses. • Industry-Government Environmental Meta-database (IGEM) Baseline Studies Database: http://www.igem.com.au/landing/ (Note – the IGEM password is documented in the SMP Operational Plan).			• 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**
36	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.	36.1	**<u>PBA baseline data acquisition in the response phase</u>** 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.
		36.2	**<u>Post Spill contact</u>** 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**
37	• Scientific monitoring will address quantitative assessment of environmental impacts of a level two or three spill or any release event with the potential to contact sensitive environmental receptors. The SMP comprises ten targeted environmental monitoring programs. • SMP supporting documentation: (1) Oil Spill Scientific Monitoring Operational Plan; (2) SMP Implementation Plan and (3) SMP Process and Methodologies Guideline. • The Oil Spill Scientific Monitoring Operational Plan details the process of SMP selection, input to the IAP to trigger operational logistic support services. Methodology documents for each of the ten SMPs are accessible detailing 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.	37.1	**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.
		37.2	**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.
		37.3	**Termination of SMP plans** The Scientific Monitoring Program will be terminated in accordance with termination triggers for the SMP’s detailed in Table C-2 of ANNEX C, and the Termination Criteria Decision-tree for Oil Spill Environmental Monitoring (Figure C-3 of ANNEX C):	Evidence of Termination Criteria triggered: • Documentation and approval by relevant stakeholders to end SMPs for specific receptor types.

5.12 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.

5.12.1 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 incident action plan (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 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.

5.12.2 Operational NEBA process

In the event of a response Woodside will confirm that the response techniques adopted at the time of Environment Plan/Oil Pollution Emergency Plan (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 Oil Pollution Emergency Arrangements (Australia). In effect the operational NEBA will determine whether there is net environmental benefit to continue response operations.

5.12.3 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 First Strike Plan). This includes notification to mariners to communicate navigational hazards introduced through response equipment and personnel.
- Identify and engage with relevant stakeholders and continually assess and review.

5.12.4 Environmental performance based on need

Table 5-25: 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 5.13)**
38	Operational NEBA	38.1	Confirm that the response techniques adopted at the time of acceptance remain appropriate to reduce the consequences of the spill within 24 hours.	1, 3A
		38.2	Record the evidence and justification for any deviation from the planned response activities.	
		38.3	Record the information and data from operational and scientific monitoring activities used to inform the NEBA.	
39	Stakeholder engagement	39.1	Prompt and record all notifications (including government notifications) for stakeholders in the region are made	
		39.2	In the event of a response, identification of relevant stakeholders will be re-assessed throughout the response period.	
		39.3	Undertake communications in accordance with: Woodside Crisis Management Functional Support Team Guideline – Reputation. External Communication Operating Standard. External Stakeholder Engagement Operating Standard.	
40	Personnel required to support any response	40.1	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.	1, 3B
		40.2	A duty roster of trained and competent people will be maintained to ensure that minimum manning requirements are met all year round.	3C
		40.3	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 Manager • People Coordinator • Public Information Coordinator • Intelligence Coordinator • Finance Coordinator.	1, 2, 3B, 3C, 4
		40.4	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.	
		40.5	S&EM advisors will be integrated into ICC to monitor performance of all functional roles.	
		40.6	Continually communicate the status of the spill and support Woodside to determine the most appropriate response by delivering on the responsibilities of their role.	
		40.7	Follow the OPEA, Operational Plans, FSPs, support plans and the IAPs developed.	1, 2, 3A, 4

		40.8	Contribute to Woodside's response in accordance with the aims and objectives set by the Duty Manager.	1, 2, 3B, 3C, 4

5.13 Measurement criteria for all response techniques

Woodside ensures compliance with environmental performance outcomes and standards through four primary mechanisms. The performance tables in this section 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)
- 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 dependent on expiry of competency certificates, staff attrition, internal rotations, leave and other absences. As such the Dashboard is designed to identify the minimum manning requirements and to identify sufficient redundancy to cater for the variances listed above.

Figure 5-2 shows the minimum manning numbers for the different hydrocarbon spill response roles and the number of qualified persons against those roles.

Woodside's pool of trained responders is composed of but not limited to personnel from the following organisations:

- Woodside internal
- AMOSC core group
- AMOSC
- OSRL
- Marine Spill Response Corporation (MSRC)
- AMSA
- Woodside contracted workforce

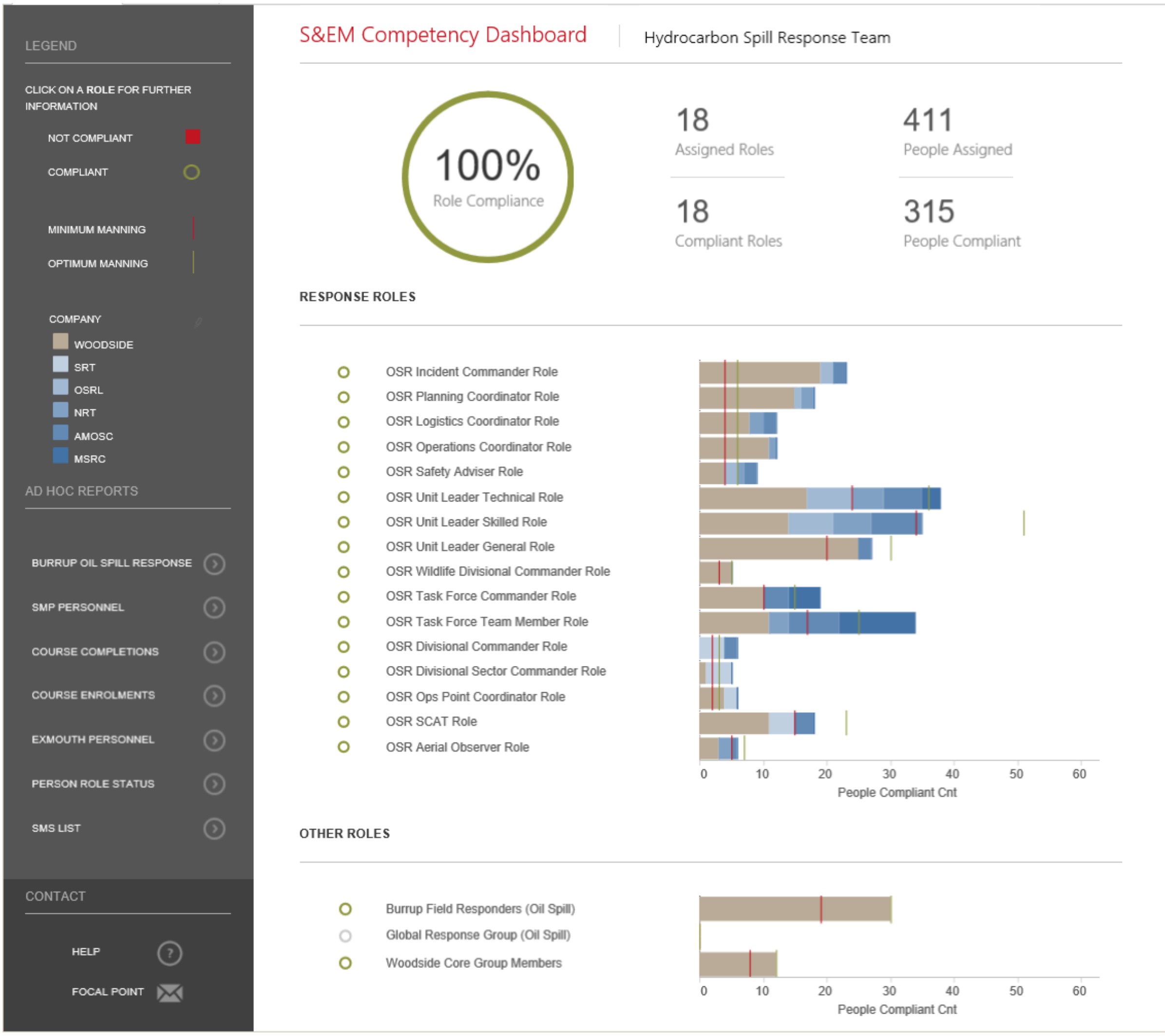

Figure 5-2: Example screen shot of the Hydrocarbon Spill Preparedness competency dashboard

The Dashboard is one of Woodside's key means of monitoring its readiness to respond. It also shows that Woodside can meet the requirements of the environmental performance standard that relate to filling certain response roles.

Figure 5-3 shows deeper dive into the Operations Point Coordinator role and the training modules required to show competence.

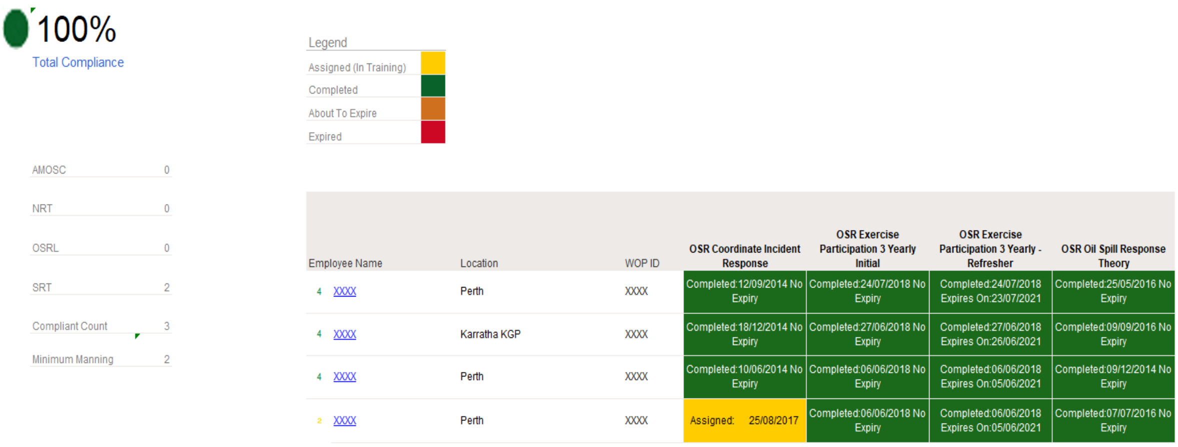

Figure 5-3: Example screen shot for the Operations Point Coordinator role

3. The Hydrocarbon Spill Preparedness ICE Assurance Process

The Hydrocarbon Spill Response Team has developed a Hydrocarbon Spill Preparedness and Response Internal Control Environment (ICE) process to align and feed into the Woodside Management System Assurance process for hydrocarbon spill. The process tracks compliance over four key control areas:

a) **Plans** – Ensures all plans (including: OPEA, FSPs, operational plans, support plans and TRPs) are current and in line with regulatory and internal requirements.
b) **Competency** – Ensures the competency dashboard is up to date and there are the minimum competency numbers across ICC, CMT and hydrocarbon spill response roles. The hydrocarbon spill training plan and exercise schedule, including testing of arrangements is also tracked. The Testing of Arrangements (TOA) register tracks the testing of all hydrocarbon spill response arrangements, key contracts and agreements in place with internal and external parties to ensure compliance.
c) **Capability** – Tracks and monitors capability that could be required in a hydrocarbon incident, including but not limited to: integrated fleet[8] 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.

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
  - 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

[8] 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

- spill equipment and services requirements.

The procedure also details the roles and responsibilities of the dedicated Woodside Hydrocarbon Spill Preparedness team. This team is responsible for:

- assuring that Woodside hydrocarbon spill responders meet competency requirements
- establishing the competency requirements, annual training schedule and a training register of trained personnel
- establishing and maintaining the total numbers of trained personnel required to provide an effective response to any hydrocarbon spill incident
- ensuring equipment and services contracts are maintained
- establishing OPEPs
- establishing OPEAs
- priority response receptor determination
- ALARP determination
- ensuring compliance and assurance is undertaken in accordance with external and internal requirements.

6 ALARP EVALUATION

This Section should be read in conjunction with Section 5 which is the capability planned for this activity.

6.1 Monitor and evaluate – ALARP assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.1.1 Monitor and evaluate – control measure options analysis

6.1.1.1 Alternative control measures

Alternative Control Measures considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Aerostat (or similar inflatable observation platform) for localised aerial surveillance.	Lead time to Aerostat surveillance is disproportionate to the environmental benefit. The system also provides a very limited field of visibility around the vessel it is deployed from.	Long lead time to access (>10 days). Each system would require an operator to interpret data and direct vessels accordingly. Requires multiple systems for shoreline use.	Purchase cost per system approx. $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. $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 Facility (KBSF) and Exmouth or can be provided by service provider.	Cost for an additional satellite tracking buoy would be $200 per day or $6,000 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 & 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 $2,000 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 $50,000 for 24hr access plus an initial $5,000 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 gained, as images from sensors (IR, UV, etc). will be low quality. Flight time limitations will be adhered to.	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
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 KBSF. 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. $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. $1M per annum, which is disproportionate to the incremental benefit this would provide, assets are already available on day 1. 2 integrated fleet vessels are available from day 1, however these could be tasked with other operations.	This option is not adopted as the area could not be accessed earlier due to safety considerations. Additionally, the cost and complexity of implementation outweighs the benefits.	No

6.1.2 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.2 Source control – ALARP assessment

Woodside has based its response planning on the loss of well containment (Credible Scenario-01) as the worst-case credible scenario (as described in Section 2.2). The accidental removal of the subsea xmas tree with an ongoing leak scenario (Credible Scenario-03) is of a significantly lesser volume, is of the same duration and the same (or fewer) source control techniques are applicable thus is not addressed separately within this section.

The following selection of primary source control and well intervention techniques would be conducted concurrently:

- ROV intervention
- debris clearance
- relief well drilling.

6.2.1 ROV intervention

Following confirmation of an emergency event, Woodside would mobilise inspection class ROVs via existing frame agreements to undertake inspection activities. The ROV available on the MODU can be deployed within 48 hours. Should the ROV on the MODU be unavailable, work class ROVs are also available through the existing frame agreements and are available for deployment within seven days (Table 6-1 and Figure 6-2).

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.

Table 6-1: ROV timings

	Estimate ROV inspection duration for PAP wells
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-GN1161), 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.

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 subsea dispersant injection (SSDI). The AMOSC SFRT would be mobilised from Fremantle. The mobilisation of the SFRT would take place in parallel with mobilisation of the SSDI equipment to ensure initial ROV surveys and debris clearance have commenced before the arrival of the SSDI equipment. 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-GN1161) 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 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:

- 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 – if required, source and contract a MODU outside Australia with an approved Australian Safety Case. This option is not required for the Nganhurra Cessation of Operations project due to the high certainty of rig availability.

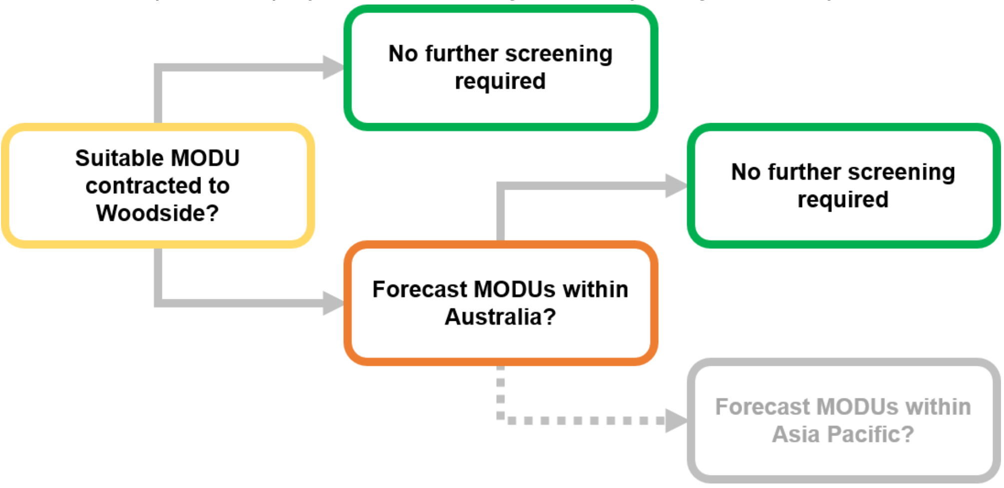

Figure 6-1: Nganhurra process for sourcing relief well MODU

Woodside has not assessed the timeframe for obtaining a relief well MODU through international supply for this project as the certainty of local supply has been confirmed. Screening of a relief well MODU from international waters is undertaken only if required, i.e. there is low confidence in local (Australian) availability. The capability, location and Australian Safety Case status is assessed for each Woodside contracted MODU. In the event the Woodside contracted MODUs are unsuitable, screening is extended to all MODUs operating in Australian Waters. The suitability and location of pre-identified relief well MODUs is tested again prior to and during the operation. Though the APPEA MoU will serve as the instrument to facilitate the transfer of drilling units and well site services between operators in the event of an emergency, Woodside will engage each of the identified titleholders in advance to maintain confidence in MODU suitability and availability.

Based on the detail provided, the Primary and Alternate approaches are expected to be achieved within the 77-day 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.

6.2.3.1 Relief well drilling timings

The duration of a blowout (from initiation to a successful kill) is assessed as 77 days for the Nganhurra ENA-01 well. Relief wells for other wells within the field are expected to be similar duration.

Details on the steps and time required to drill a relief well is shown in Table 6-2 below. A dynamically positioned (DP) MODU will be used in the event that one is available and within a shorter range/ response time than a moored MODU, however, DP MODUs are not readily available in Australia and thus the predictions for moored MODUs in the table are the most likely scenario during a real event.

On a monthly basis, Woodside tracks and assesses the suitability of available MODUs internally and externally, plus MODU activities of registered operators and MODUs with approved safety cases. MODUs expected to be stationed in Australia for the duration of project are identified as part of the Relief Well Peer review conducted during the planning phase and immediately prior to spud.

The ability to meet MODU mobilisation of 21 days is screened based on where the pre-identified MODUs will be stationed. For this project, suitable MODUs based in Australia have been identified by Woodside and thus there is a high level of confidence that the stated 21-day timeframe can be met.

To validate the effectiveness of the relief MODU supply arrangements through the APPEA MoU, the 21-day mobilisation period was tested in April 2019 in an exercise facilitated by an external party. This exercise included suspension of the assisting operator’s activities, contracting the MODU, vessel safety case revision and transit to location. The testing of mobilisation arrangements has been incorporated into Woodside’s Hydrocarbon Spill Arrangements Testing Schedule.

Table 6-2: Relief well drilling timings

	Estimate Relief Well duration for Nganhurra Drilling and Subsea Installation Well (days) – Moored
Source and contract MODU comprising the following stages:	**21 days total:**
Activate MOU.	*8 days*
Secure and suspend well.	
Complete relief well design.	
Secure relief well materials.	
Transit to location based on mobilisation from Northwest shelf region.	*2 days*
Backload and loadout bulks and equipment.	*2 days*
Complete internal assurance of relief well design.	
Contingency for unforeseen event e.g. longer transit from another area of Australia, problems in securing well, cyclone event.	*9 days*
Pre-spud survey	**Already included – concurrent with MODU mobilisation above**
Mooring Spread Installation *NB Occurs in parallel with the 21 days to mobilise the rig, so the timing included here is the difference.*	**15.8 days**
Drilling, casing and test BOP estimate	**25.9 days**
Intersection & well kill comprising the following stages:	**14 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*
	76.7 days (77 days)

The following conditions and assumptions are applicable:

- The 21-day mobilisation time assumes a local MODU is available in Australia with other operator and regulatory approvals do not delay the spud date.
- A dynamically positioned MODU is not available.
- A pre-lay mooring spread is required to moor the rig over subsea infrastructure. Mobilisation 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	21
Install pre-lay spread	7
Run anchors and prepare to spud	1.8
Total	**36.8**

- Whilst Woodside will make every endeavour to accelerate these activities to reduce the pre-lay mooring timeframe, Woodside believes they are sufficiently conservative to ensure these activities can be completed. Woodside has considered a broad range of alternate, additional, and improved options as outlined in Section 6.2.4.
- Intersect and kill duration is estimated at 14 days. This is a moderately conservative estimate. During the intersect process, the relief well will be incrementally drilled and logged to accurately approach and locate the existing well bore. This will result in the highest probability of intersecting the well on the first attempt and thus will reduce the overall time to kill the well. During the Montara incident, it took five attempts to achieve a successful intersect.

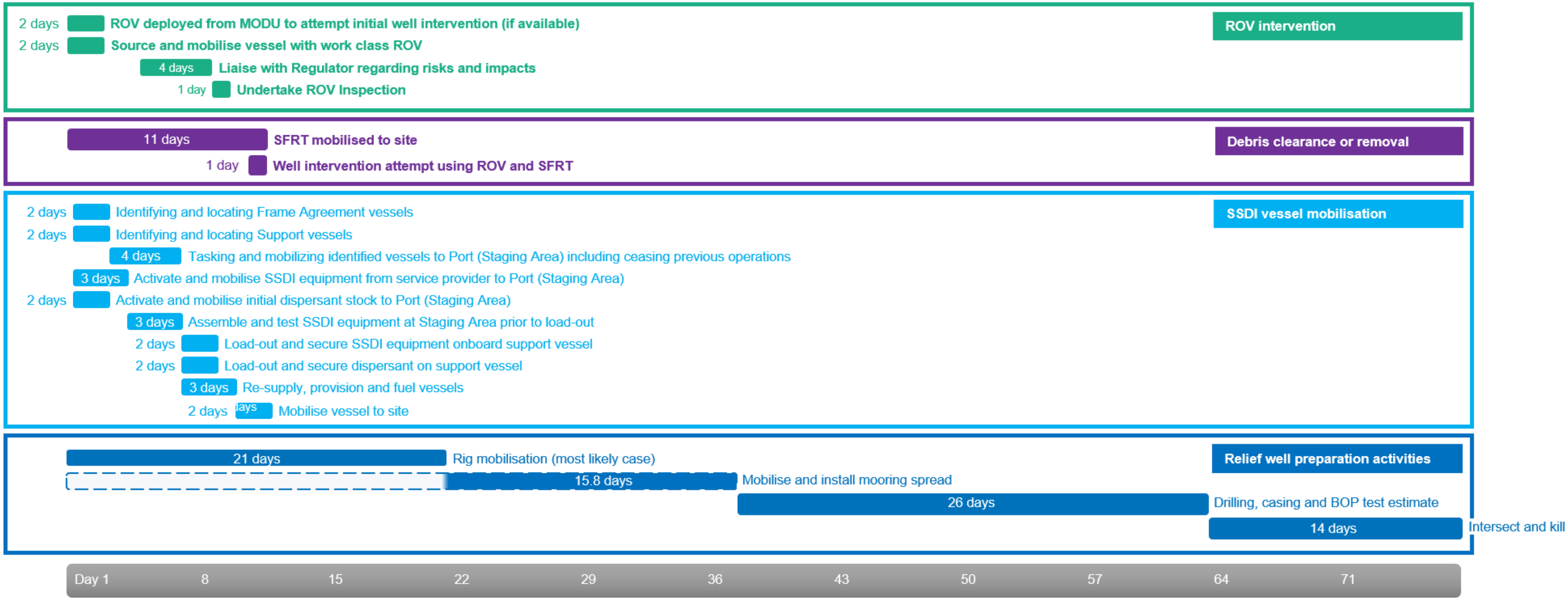

Figure 6-2: Source control and well intervention response strategy deployment timeframes

6.2.3.2 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.

These include;

- Access to Safety and Risk discipline personnel with specialist knowledge.
- Monitoring internal and external rigs and vessel availability in region and extended area through contracted arrangements on a monthly basis.
- 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 Nganhurra Cessation of Operations project, including the associated site-specific well hazards. As such, there is less new detail for the regulator to review and should present a short review timeframe with no impact expected to the commencement of relief well drilling activities.

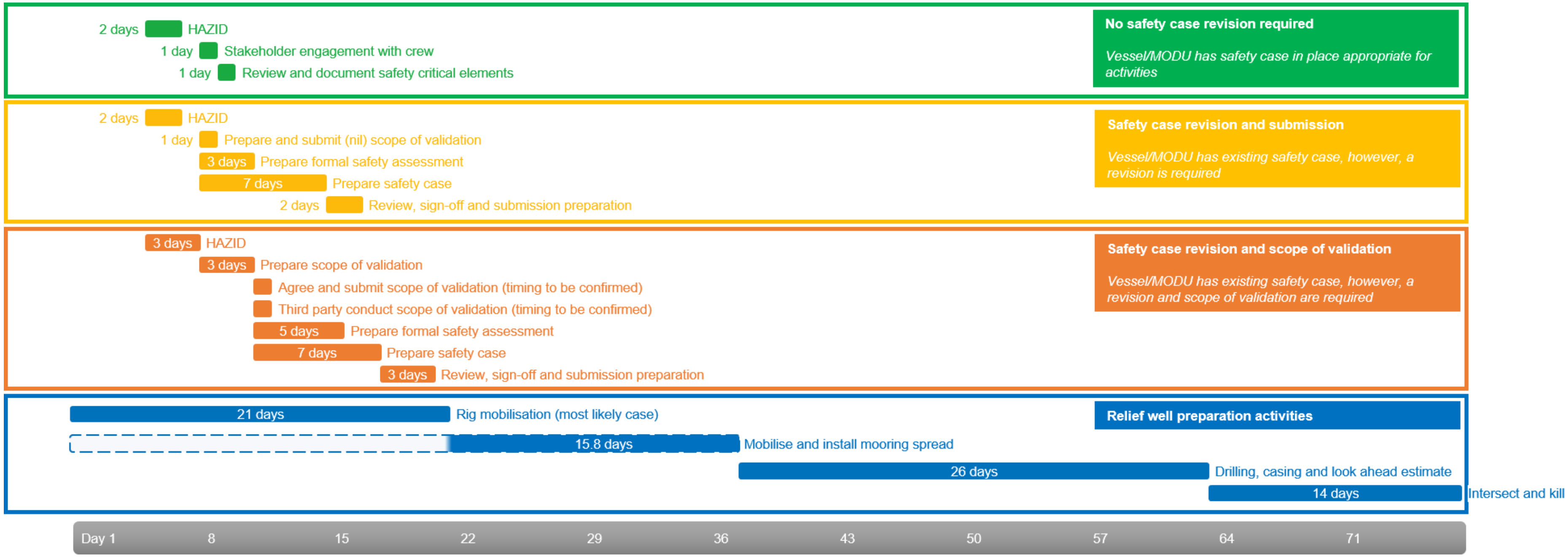

Figure 6-3: Timeline showing safety case revision timings alongside other relief well preparation activity timings

Table 6-4: Safety case revision conditions and assumptions

Case	No safety case revision required	Safety case revision and submission	Safety case revision and scope of validation
Description	Vessel/MODU has a safety case in place appropriate for activities.	Vessel/MODU has an existing safety case, however, a revision is required.	Vessel/MODU has an existing safety case, however, a revision is required plus scope of validation.
Conditions/ assumptions	Assumes that existing vessel/MODU safety case covers working under the same conditions or the loss of containment is not severe enough to result in any risk on the sea surface.	Safety case timing assumes vessel/MODU selected and crew and available for workshops and safety case studies.	Safety case timing assumes vessel/ MODU selected and crew and available for workshops and safety case studies.
		Assumes nil scope of validation. This assumes that the vessel for SSDI allows for working in a hydrocarbon environment and control measures are already in place in the existing safety case. For MODU, it assumes that the relief well equipment is already part of the MODU facility and MODU safety case.	Validation will be required for new facilities only. The time needed for the validator to complete the review (from the last document received) and prepare validation statement is undetermined. This is not accounted for here as the safety case submission is not dependent on the validation statement, however the safety case acceptance is.
		Assumes safety case preparation is undertaken 24/7.	Assumes safety case preparation is undertaken 24/7.

6.2.4 Source control – control measure options analysis

The assessments described in Sections 6.2.1, 6.2.2 and 6.2.3 outline the primary and alternate approaches that Woodside would implement for source control.

Woodside has outlined the options considered against the activation/mobilisation (alternative, additional and improved options), deployment (additional and improved options) process described in Section 2.1.1 that 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.

6.2.4.1 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

6.2.4.2 Deployment options considered

Additional

- Pre-drilling top-holes
- Purchase and maintain mooring system
- Contract in place with WWCI and Oceaneering

Improved

- Maintaining relief well drilling supplies (mud, casing, etc).

6.2.5 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 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 disproportionate compared to the environmental benefit.

6.2.5.1 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 may allow the well to be killed up to 10 days sooner (total of 67 days for well kill) and may result in a reduction of up to 1840 m^3 of Enfield Crude for the worst-case credible scenario.	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 may result in a reduction of up to 2576 m^3 of Enfield Crude for the worst-case credible scenario.	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

6.2.5.2 Additional control measures

Additional Control Measures Considered
Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures

Option considered	Feasibility	Environmental benefits/impacts	Approximate cost	Assessment conclusions	Implemented
Implement and maintain minimum standards for Safety Case development	Woodside's contingency planning consideration would be to source a rig from outside Australia with an existing Safety Case. This would require development and approval of a safety case revision for the rig and activities prior to commencing well kill operations.	This option is considered feasible and would require Woodside to develop minimum standards for safe operations for relevant Safety Case input along with maintaining key resources to support review of Safety Cases. Woodside would not be the operator for relief well drilling and would therefore not develop or submit the Safety Case revision. Woodside's role as Titleholder would be to provide minimum standard for safe operations that MODU operators would be required to meet and/or exceed.	Woodside has outlined control measures and performance standards regarding template Safety Case documentation and maintenance of resources and capability for expedited Safety Case review.	This option has been selected based on its feasibility, low cost and the potential environmental benefits it would provide.	Yes

6.2.5.3 Improved control measures

Option considered	Feasibility	Environmental benefits/impacts	Approximate cost	Assessment conclusions	Implemented
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*					
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 for Woodside to understand what other rigs may 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 rigs is for Woodside to understand what other rigs may be rapidly available for relief well operations if required, potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	The cost is minimal.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes

6.2.6 Deployment – control measure options analysis

6.2.6.1 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**	**Cost**	**Assessment conclusions**	**Implemented**
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 18 wells as the worst-case scenarios.	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 Wild Well Control and Oceaneering	Woodside has an agreement in place with Wild Well Control Inc 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 mobilization 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 considered proportionate to any environmental benefit that might be realised.	Yes

6.2.6.2 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**	**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

6.2.7 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 Wild Well Control and Oceaneering to supply trained, competent personnel

- Improved
  - Monitor internal drilling programs for MODU availability
  - Monitor external activity for MODU availability
  - Monitor status of Registered Operators / Approved Safety cases for MODUs

6.3 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**	**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**	**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**	**Cost**	**Implemented**
No reasonably practical alternative control measures identified.				N/A

6.3.2 Selected control measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.4 Subsea dispersant injection – ALARP assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.4.1 Subsea dispersant injection timing

The scope of existing safety cases for Frame Agreement vessels includes all relevant activities for SSDI operations. Depending on the location and availability of vessels, Woodside expects the SSDI capability can be mobilised to site for deployment within 12 days. This may be able to be achieved faster if vessels are closer to appropriate staging areas and not already involved in other operations. The following steps are included within the indicative timeframe and many of these are expected to be concurrent activities. The timing of these activities is also shown alongside other source control activities in Table 6-2.

1. Identifying and locating Frame Agreement vessels (1-2 days)
2. Identifying and locating Support vessels (1-2 days)
3. Tasking and mobilizing identified vessels to Port (Staging Area) including ceasing previous operations (2-4 days)
4. Activate and mobilise SSDI equipment from service provider to Port (Staging Area) (2-3 days)
5. Activate and mobilise initial dispersant stock to Port (Staging Area) (1-2 days)
6. Assemble and test SSDI equipment at Staging Area prior to load-out (2-3 days)
7. Re-supply, provision and fuel vessels (1-2 days)
8. Load-out and secure SSDI equipment onboard ISV (1-2 days)
9. Load-out and secure Dispersant on Support Vessel (1-2 days)
10. Contingency for unforeseen events (1 day)

6.4.2 Response planning: Nganhurra Cessation of Operations WCCS (Credible Scenario-01)

Following a loss of well control it may take 2-5 days to complete a risk assessment, discuss and agree appropriate control measures with NOPSEMA (Safety, Environment and Well Integrity divisions), and monitor the operating environment within the Petroleum Safety Zone around a well or facilities. Subsea dispersant injection is unlikely to be deployed until approximately Day 12, subject to subsea ROV survey of the site and agreement of risk assessment and recommended control measures to ensure personnel safety.

Dispersant efficacy testing has not been undertaken for subsea conditions, but industry experience estimates a subsea amenability to dispersant of approximately 50-60% effectiveness. Based on response planning assumptions outlined in Section 5, the subsea dispersant injection system (as part of the SFRT package) is able to deliver approx. 60-75 m³ per day on a continuous 24 hour / 7 day basis.

For the purpose of capability demonstration below, Woodside has shown that once the SSDI system arrives and is able to be deployed safely, sufficient capability exists to commence and continue SSDI until the well is killed (approximately day 77).

Table 6-5: Response planning – subsea dispersant injection

	Subsea Dispersant Injection (SSDI)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
	Oil Release												
R1	Oil Release Rate (Nganhurra Cessation of Operations) - m³	235	235	235	235	235	184	184	1,288	1,288	1,288	5,152	3,864
A	**Capability available - m³**												
A1	Predicted oil volume treated by SSDI (lower)	0	0	0	0	0	0	0	0	3,600	12,600	50,400	50,400
A2	Predicted oil volume treated by SSDI (upper)	0	0	0	0	0	0	0	4,500	9,000	31,500	126,000	126,000
A3	Dispersant application volume (lower)	0	0	0	0	0	0	0	0	120	420	1,680	1,680
A4	Dispersant application volume (upper)	0	0	0	0	0	0	0	75	150	525	2,100	2,100
B	**Subsea release oil remaining - m³**												
B1	Predicted oil volume not treated (Credible Scenario-01) (lower)	235	235	235	235	235	184	184	1,288	-2,312	-11,312	-45,248	-46,536
B2	Predicted oil volume not treated (Credible Scenario-01) (upper)	235	235	235	235	235	184	184	-3,212	-7,712	-30,212	-120,848	-122,136

A1 and A2 – the upper and lower volumes in m³ that subsea dispersant injection may be able to treat (based on response planning assumptions in Section 5 and volumes in A3 and A4). These are based on a 1:50 ratio for A1 and a 1:100 ratio for A2

A3 and A4 - the upper and lower volumes in m³ of the associated dispersant injection volumes for A1 and A2,

B1 and B2 – the upper and lower volumes in m³ of the subsea oil that is not treated on each day, following predicted treatment outlined in A1 and A2 (oil released - predicted oil volume treated (R1-A1)). Negative numbers indicate an exceedance of available capability versus need.

6.4.3 Subsea dispersant injection – 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	Cost	Assessment Conclusions	Implemented
Dedicated, contracted ISV for SSDI mobilisation and deployment (based in Australia)	Reducing the mobilisation and deployment time of the SSDI through vessel standby/pre-positioning is unlikely to result in a significant change in environmental benefit. Under current arrangements the SSDI system can be on location from approx. day 12 depending on ISV availability where a dedicated, contracted vessel may enable the SSDI system on location from day 10. Once deployed the SSDI will be utilised to increase entrainment of released oil and to ensure safe operations for surface deployment of SFRT and other surface response techniques.	A modified Construction vessel or vessels with suitable remote operated underwater vehicles (ROVs) is required to load, transport and deploy the SSDI system. The critical element in deployment of the SSDI is the availability of an appropriate ISV. Achieving a shorter mobilisation would require the vessel's work schedule to be permanently restricted so as to permit a quicker return to Exmouth, reducing the utilisation of the vessel, or the permanent retention of a dedicated ISV. Neither option is considered reasonably practicable. Acceleration is limited by availability of the SSDI system mobilisation and this control measure is not expected to reduce the estimated extent and magnitude of impact from a well release on receptor locations compared with the proposed mobilisation plan using pre-identified or vessels available through frame agreements.	A dedicated vessel on standby in Exmouth, ready to load is estimated to cost A$20 m per annum. This is considered cost-prohibitive for the PAP.	This response strategy is not considered as a primary response and this control measure is not adopted as the cost, complexity and feasibility is considered disproportionate to the minor environmental benefit that might be gained	No
Shared, contracted ISV for SSDI mobilisation and deployment (shared between Titleholders)	Reducing the mobilisation and deployment time of the SSDI through vessel standby/pre-positioning is unlikely to result in a significant change in environmental benefit. Under current arrangements the SSDI system can be on location from approx. day 12 depending on ISV availability where a dedicated, contracted vessel may enable the SSDI system on location from day 10. Once deployed the SSDI will be utilised to increase entrainment of released oil and to ensure safe operations for surface deployment of SFRT and other surface response techniques.	A modified Construction vessel or vessels with suitable remote operated underwater vehicles (ROVs) is required to load, transport and deploy the SSDI system. The critical element in deployment of the SSDI is the availability of an appropriate ISV. Achieving a shorter mobilisation would require the vessel's work schedule to be permanently restricted so as to permit a quicker return to Exmouth, reducing the utilisation of the vessel, or the permanent retention of a dedicated ISV. Neither option is considered reasonably practicable. This option is not considered feasible for a number of Titleholders due to the remote distances in Australia as well as a substantial range of well depths, types, complexities, geologies and geophysical properties across a range of Titleholders. Additionally, acceleration is limited by availability of the SSDI system mobilisation and this control measure is not expected to reduce the estimated extent and magnitude of impact from a well release on receptor locations compared with the proposed mobilisation plan using pre-identified or vessels available through frame agreements.	A dedicated vessel on standby in Exmouth, ready to load is estimated to cost A$20 m per annum. As a shared cost across a range of titleholders, this may be approximately A$2 m each. This is considered cost-prohibitive for the PAP.	This response strategy is not considered as a primary response and this control measure is not adopted as the cost, complexity and feasibility is considered disproportionate to the minor environmental benefit that might be gained by 1-2 days of additional subsea dispersant injection.	No

6.4.3.2 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	Cost	Assessment Conclusions	Implemented
Pre-identifying/ contracting vessels through Frame Agreements for SSDI loading and operations	Ensuring the mobilisation and deployment time of the SSDI through vessel availability/ contracting strategy is likely to result in a moderate environmental benefit as using these arrangements, the SSDI will be on location from approximately Day 12.	Achieving a shorter mobilisation would require the vessel being on standby with limited duties to permit a faster return to Exmouth and this is not considered reasonably practical. Woodside has established frame agreements with vessel providers and will track availability of similar vessels. These options are both considered reasonably practicable.	Associated cost of implementation is minimal to the environmental benefit gained.	This control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

6.4.3.3 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**
No reasonably practical improved control measures identified.					

6.4.4 Selected control measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - Pre-identifying / contracting vessels through Frame Agreements for SSDI loading and operations
- Improved
  - None selected

6.5 Surface dispersant application – ALARP assessment

Deterministic modelling results predict that surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for surface dispersant application to be effective at any point during the modelled period (77 days). As a conservative approach, Woodside has included this as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed.

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 – surface dispersant application

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 are displayed as ranges from lower to upper to incorporate operational factors such as weather, daylight, crew/vessel/aircraft location and duties prior to deployment, survey or classification society inspection requirements for vessels, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling /re-stocking provisioning, and other similar logistics and operational limitations that are beyond Woodside's direct control.

Table 6-6: Existing capability – surface dispersant application

E	Existing Capability												
E1	Existing level of surface dispersant application capability available – Aerial Dispersant Application (m^3)												
	Existing capability - Surface Dispersant Application	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
	By Volume – m^3												
E1.1	Predicted oil contacted by surface dispersant (lower) - m^3	0	113	463	938	1,050	1,213	1,213	8,488	8,488	8,488	36,375	36,375
E1.2	Predicted oil dispersed by surface dispersant (lower) - m^3	0	52	213	431	483	558	558	3,904	3,904	3,904	16,733	16,733
E1.3	Predicted oil contacted by surface dispersant (upper) - m^3	0	885	1,260	2,385	2,385	2,385	2,385	16,695	16,695	16,695	71,550	71,550
E1.4	Predicted oil dispersed by surface dispersant (upper) - m^3	0	730	1,040	1,968	1,968	1,968	1,968	13,773	13,773	13,773	59,029	59,029
E1.5	Dispersant delivery available (lower) - m^3	0	9	37	75	84	97	97	679	679	679	2,910	2,910
E1.6	Dispersant delivery available (upper) - m^3	0	59	84	159	159	159	159	1,113	1,113	1,113	4,770	4,770
	By Surface Area– km^2												
E1.7	Predicted surface area treated by surface dispersant (lower) – km^2	0	2	7	15	17	19	19	136	136	136	582	582
E1.8	Predicted surface area treated by surface dispersant (upper) – km^2	0	12	17	32	32	32	32	223	223	223	954	954
E2	Existing level of surface dispersant capability available – Vessel Dispersant Application (m^3)												
	By Volume - m^3												
E2.1	Predicted oil contacted by surface dispersant (lower) - m^3	50	50	50	50	100	100	100	700	700	700	3,000	3,000
E2.2	Predicted oil dispersed by surface dispersant (lower) - m^3	23	23	23	23	46	46	46	322	322	322	1,380	1,380
E2.3	Predicted oil contacted by surface dispersant (upper) - m^3	80	160	320	320	320	480	480	2,240	2,240	2,240	6,000	6,000
E2.4	Predicted oil dispersed by surface dispersant (upper) - m^3	66	132	264	264	264	396	396	1,848	1,848	1,848	4,950	4,950
E2.5	Dispersant delivery available (lower) - m^3	8	8	8	8	16	16	16	112	112	112	480	480
E2.6	Dispersant delivery available (upper) - m^3	8	16	32	32	32	48	48	224	224	224	600	600
	By Surface Area – km^2												
E2.7	Predicted surface area treated by surface dispersant (lower) – km^2	2	2	2	2	3	3	3	22	22	22	96	96
E2.8	Predicted surface area treated by surface dispersant (upper) – km^2	2	3	6	6	6	10	10	45	45	45	120	120

6.5.2 Response planning: Nganhurra Cessation of Operations – loss of well containment (Credible Scenario-01)

Deterministic modelling scenarios indicate that first shoreline impact is at Mangrove Bay within 21 days (0.882 m³) for the Nganhurra Cessation of Operations WCCS scenario (Credible Scenario-01). Modelling results at defined response thresholds (>50 g/m²) indicate that the subsea release from Credible Scenario-01 is not expected provide any opportunities for surface dispersant application or containment and recovery due to release rates, droplet size at the well head and significant weathering of the hydrocarbon through the water column.

Current capability will meet the required response need from Day 1 as modelling predicts there will be no hydrocarbon present at the required threshold for surface dispersant application. Applying dispersant at very low concentrations would not provide a net environmental benefit.

Throughout the release duration, modelling also shows the surface slick moving toward WA State Waters and the mainland coast where surface dispersant application is unlikely to be an available response technique due to water depth and potential impacts of the dispersed oil plume.

Table 6-7: Response planning Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – release volumes

Nganhurra Cessation of Operations – loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day		Week	Week	Week		Month	Month
		1	2	3	4	5	6	7		2	3	4		2	3
	Oil on sea surface														
A	Total volume of oil released (subsea) – m³	235	235	235	235	235	184	184		1,288	1,288	1,288		5,152	3,864
B	Cumulative volume released – m³	235	470	705	940	1,175	1,359	1,543		2,831	4,119	5,407		10,559	14,456
C	Total volume of surface oil remaining after weathering (per day) – m³	89	89	89	89	89	70	70		489	489	489		1,958	1,468

A and B - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge scenario of the Nganhurra Cessation of Operations well. The total volume for this spill is released over approx 77 days with an initial daily flow rate of 235 m³ / day reducing over time and a total release volume of 14,456 m³.

C - Enfield Crude (API 22.5°) contains a high proportion (~38% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a high dynamic viscosity (46.0 cP). The pour point of the whole oil (< -36 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures and which would begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 3% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 16% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 43% should evaporate over several days (265 °C < BP < 380 °C). Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. No information has been made available to allow judgement as to whether or not the mixture will eventually solidify or sink as it weathers.

Table 6-8: Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – treatable hydrocarbons

Nganhurra Cessation of Operations – loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day		Week	Week	Week		Month	Month
		1	2	3	4	5	6	7		2	3	4		2	3
C	Treatable hydrocarbons following weathering														
C1	Surface oil volume >50 g/m² – m³	0	0	0	0	0	0	0		0	0	0		0	0
	Dispersible hydrocarbons														
C2	Surface oil volume >50 g/m² and viscosity <15,000 cSt – m³	0	0	0	0	0	0	0		0	0	0		0	0

C1 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50 g/m². Based on the information outlined in Section 2.3.2.1regarding surface concentration thresholds, this is the total volume of oil that can be treated by containment and recovery and surface dispersant spraying operations.

C2 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50 g/m² and below 15,000 cSt. This is the total volume of oil that can potentially be treated by surface dispersant spraying operations.

6.5.2.1 Response planning need: Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – summary

Offshore response operations will always be guided by Operational Monitoring to target the thickest part of the slick, typically BAOAC 5 – continuous true oil colour with a surface oil concentration >200 g/m² and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200g/m².

For a subsea release, the slick does not have a leading edge similar to a surface release so hydrocarbons will surface over a broad area and typically as thin sheens or small discrete patches of oil. As the spill continues to weather and spread over a number of days and weeks, the surface concentration and surface area of continuous oil colour spreads and reduces to discontinuous true oil colour and finally sheen as shown above.

The response need for this scenario is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-8 above. For the Nganhurra Cessation of Operations loss of well containment scenario (Credible Scenario-01), due to the chemical and physical properties of the oil and subsea release, there is no surface oil predicted at BAOAC 4 or 5 throughout the deterministic model run. In order to maximise the effectiveness of response operations, Woodside would deploy surface dispersant spraying to target thick patches of oil based on operational monitoring observations. This approach would result in the greatest volume and surface area treated by surface dispersant operations but may also limit the geographic area and effectiveness of containment and recovery as these operations cannot be conducted under or near the surface dispersant spraying operations due to personnel safety reasons. In evaluating the response need for offshore operations, surface dispersant application is prioritised for BAOAC 4.

Table 6-9: Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – response planning need

Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day	Week	Week	Week	Month	Month
		1	2	3	4	5	6	7	2	3	4	2	3
D	**Response Planning Need**												
D1	**Bonn Agreement Oil Appearance Code (BAOAC) 5 – Continuous True oil colour**												
	Volume of surface oil BAOAC 5 (>200 g/m²) - m³	0	0	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) and <15,000 cSt - m³	0	0	0	0	0	0	0	0	0	0	0	0
D2	**Bonn Agreement Oil Appearance Code (BAOAC) 4 – Discontinuous True oil colour**												
	Volume of surface oil BAOAC 4 (50-200 g/m²) - m³	0	0	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 4 (50-200 g/m²) and <15,000 cSt - m³	0	0	0	0	0	0	0	0	0	0	0	0
D3	**Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen**												
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m²) - m³	235	470	705	940	1,175	1,359	1,543	2,831	4,119	5,407	10,559	14,456

6.5.2.2 Surface dispersant operations loss of well containment (Credible Scenario-01): surface volume

Surface Dispersant operations using vessels and aircraft would target any identified heavy (BAOAC 4 and 5) patches of oil as this technique is able to treat larger volumes and surface areas than containment and recovery and is subject to a window of opportunity (prior to spreading below 50 g/m² and/or viscosity increasing above 15,000 cSt).

As previously noted, surface hydrocarbon concentrations required for surface dispersant application are not predicted to be present at any time during the period modelled. Should dispersant be selected as an appropriate response during a real spill event, Woodside would expect 1 Fixed Wing Aerial Dispersant Contract (FWADC) aircraft along with 1 larger aircraft from OSRL, to be operating from airfields in Exmouth contacting from 96 m³ to 537 m³ plus 1-2 vessels conducting dispersant spraying treating 40 m³ to 160 m³ of surface oil by Day 2.

This capability is ALARP and no further options to increase capability have been adopted.

6.5.3 Surface dispersant application – control measure options analysis

6.5.3.1 Alternative control measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Dedicated Response Vessel in region (exclusive to Woodside)	The environmental benefits associated with surface dispersant application are described above. The additional environmental benefit obtained from immediate access to this equipment, permitting deployment as soon as conditions became favourable, would result in a negligible environmental benefit (25-40 m^3 of oil contacted resulting in approximately 12-26 m^3 of oil treated) based on one operation.	Chartering and equipping additional vessels on standby has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated availability of vessel and FWADC resources which have a similar dispersant delivery capacity and are available from Day 2 to treat the spill. The effectiveness of this control (weather dependency, availability and survivability) is rated as very low.	The cost A($15 m per annum for the PAP) and organisational complexity of employing a dedicated response vessel is considered disproportionate to the minor environmental benefit to be realised by implementing this control.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Dedicated Response Vessel in region (shared resource)	The environmental benefit would be similar to that described above for Woodside integrated fleet vessels.	Additional resources and capability can be contracted should the need arise, and dispersant build-up is capable of satisfying additional demand.	The cost and complexity of implementing and maintain this alternative control measure is considered high given the predicted effectiveness. Even with consideration of shared costs, the minor benefit of this control measure does not justify the cost.	This option is not adopted as the complexity and cost are disproportionate to the minimal potential environmental benefit.	No

6.5.3.2 Additional control measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Lease/purchase additional spray systems and/or dispersant stocks (based at Exmouth/Dampier)	Purchase of additional system(s) and/or dispersant stocks would not provide a significant environmental benefit compared to the current capability in place.	Time to set up and mobilise a marine charter vessel is ~10 days, at which point existing surface dispersant application systems are available for loading onto vessels. Adding additional spray systems would allow for extra surface dispersant application capacity but is unlikely to reduce deployment times for this strategy.	For the WCCS, additional surface dispersant (vessel) spray systems and large quantities of dispersant are already available through AMOSC, AMSA and OSRL therefore the cost is considered disproportionate to the minor benefit gained.	This option is not adopted as the current capability meets the need.	No
Train additional Woodside personnel in Exmouth to coordinate vessel dispersant application	Limited environmental benefit to be gained by training additional personnel.	Current capability meets need. Woodside has a pool of trained, competent offshore responders / team leaders at strategic locations to ensure timely and sustainable response. Additional personnel are available through current contracts with AMOSC and OSRL and agreements with AMSA. Marine standards & guidelines ensure vessel masters are competent for their roles. Regular audits of oil spill response organisations ensure training and competency is maintained.	Minor additional cost regarding training and maintenance of competency.	This option is not adopted as the current capability meets the need.	No

6.5.3.3 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**
Locate vessel spraying equipment on additional in-field support vessel(s)	This option may achieve minor incremental improvements in surface oil and residual oil volumes similar to those described for integrated fleet vessels. However, given the likely vessel re-supply times involved to/from the offshore spill location, this option is unlikely to realise material environmental benefits additional the capability selected.	Woodside currently has dispersant spray systems pre-located on vessels used in-field during cargo transfer activities. Consideration of equipping additional vessels with similar equipment was made but is not being carried through to implementation.	The option is reasonably practicable and the cost (charter and operational/maintenance costs) is expected to be moderate, particularly when compared with the ability to rapidly commence spraying operations, subject to safety considerations but Woodside considers the existing control measures to be sufficient for the need.	This option is not adopted as the current capability meets the need.	No

6.5.4 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

6.6 Containment and recovery – ALARP assessment

Deterministic modelling results predict that surface oil concentrations will not meet the 50 g/m² minimum concentration threshold required for containment and recovery to be effective at any point during the modelled period (77 days). As a conservative approach, Woodside has included this as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed.

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 – containment and recovery

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours per day. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

Table 6-10: Existing capability – containment and recovery

E	Existing Capability														
Existing Capability – Containment and Recovery		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		Week 2	Week 3	Week 4		Month 2	Month 3
E3	Existing level of containment and recovery capability available (m^3 recovered per day)														
	By Volume – m^3														
E3.1	Predicted oil recovered by containment and recovery (lower) – m^3	0	23	23	92	92	138	161		1,127	1,127	1,127		4,830	4,830
E3.2	Predicted oil recovered by containment and recovery (upper) – m^3	90	90	270	360	450	540	720		5,040	5,040	5,040		21,600	21,600

6.6.2 Response planning: Nganhurra Cessation of Operations – loss of well containment (Credible Scenario-01)

Deterministic modelling scenarios indicate that first shoreline impact is at Mangrove Bay within 21 days (0.882 m^3) for the Nganhurra Cessation of Operations WCCS scenario (Credible Scenario-01). Modelling results at defined response thresholds (>50 g/m^2) indicate that the subsea release from Credible Scenario-01 is not expected provide any opportunities for containment and recovery due to release rates, droplet size at the well head and significant weathering of the hydrocarbon through the water column.

Current capability will meet the required response need from Day 1 as modelling predicts there will be no hydrocarbon present at the required threshold for containment and recovery operations.

For the purpose of capability demonstration below, Woodside has demonstrated that sufficient capability exists to commence and continue containment and recovery.

Table 6-11: Response planning Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – release volumes

Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day	Week	Week	Week	Month	Month
		1	2	3	4	5	6	7	2	3	4	2	3
	Oil on sea surface												
A	Total volume of oil released (subsea) - m^3	235	235	235	235	235	184	184	1,288	1,288	1,288	5,152	3,864
B	Cumulative volume released – m^3	235	470	705	940	1,175	1,359	1,543	2,831	4,119	5,407	10,559	14,456
C	Total volume of surface oil remaining after weathering (per day) - m^3	89	89	89	89	89	70	70	489	489	489	1,958	1,468

A and B - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge scenario of the Nganhurra Cessation of Operations well. The total volume for this spill is released over approximately 77 days with an initial daily flow rate of 235 m^3 / day reducing over time and a total release volume of 14,456 m^3.

C - Enfield Crude (API 22.5°) contains a high proportion (~38% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a high dynamic viscosity (46.0 cP). The pour point of the whole oil (< -36 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures and which would begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 3% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 16% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 43% should evaporate over several days (265 °C < BP < 380 °C). Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. No information has been made available to allow judgement as to whether or not the mixture will eventually solidify or sink as it weathers.

Table 6-12: Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – treatable hydrocarbons

Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day	Week	Week	Week	Month	Month
		1	2	3	4	5	6	7	2	3	4	2	3
C	Treatable hydrocarbons following weathering												
C1	Surface oil volume >50g/m^2 – m^3	0	0	0	0	0	0	0	0	0	0	0	0

C1 – indicates the total remaining volume of hydrocarbons in cubic metres (m^3) on the sea surface above 50 g/m^2. Based on the information outlined in Section 2.3.2.1 regarding surface concentration thresholds, this is the total volume of oil that can be treated by containment and recovery and surface dispersant spraying operations.

6.6.2.1 Response planning need: Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – summary

Offshore response operations will always be guided by Operational Monitoring to target the thickest part of the slick, typically BAOAC 5 – continuous true oil colour with a surface oil concentration >200 g/m^2 and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200 g/m^2. For a subsea release, the slick does not have a leading edge similar to a surface release so hydrocarbons will surface over a broad area and typically as thin sheens or small discrete patches of oil. As the spill continues to weather and spread over a number of days and weeks, the surface concentration and surface area of continuous oil colour spreads and reduces to discontinuous true oil colour and finally sheen as shown above.

The response need is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-11 above. While surface dispersant operations target the leading edge of the slick where surface concentration and viscosity thresholds are met, containment and recovery operations would be deployed behind the surface dispersant application area to target discrete patches of thick oil at BAOAC 4 and 5 and remaining oil that is not dispersed.

Table 6-13: Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01) – response planning need

Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		Week 2	Week 3	Week 4		Month 2	Month 3
D	Response Planning Need														
D1	Bonn Agreement Oil Appearance Code (BAOAC) 5 – Continuous True oil colour														
	Volume of surface oil BAOAC 5 (>200 g/m^2) - m^3	0	0	0	0	0	0	0		0	0	0		0	0
D2	Bonn Agreement Oil Appearance Code (BAOAC) 4 – Discontinuous True oil colour														
	Volume of surface oil BAOAC 4 (50-200 g/m^2) - m^3	0	0	0	0	0	0	0		0	0	0		0	0
D3	Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen														
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m^2) - m^3	235	470	705	940	1,175	1,359	1,543		2,831	4,119	5,407		10,559	14,456

6.6.2.2 Containment and recovery operations Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01): surface volume

Containment and recovery operations would target discrete patches of oil identified by operational monitoring activities for a surface release. This technique is secondary to surface dispersant application.

To remove the majority of the surface hydrocarbons before shoreline contact would require the removal of the available surface oil >50 g/m^2 on each day. As previously noted, surface hydrocarbon concentrations required for containment and recovery operations are not predicted to be present at any time during the period modelled. Should containment and recovery be selected as an appropriate response during a real spill event, Woodside would expect 1 containment and recovery operation removing up to 31 m^3 surface oil by Day 1 and increasing to 6 containment and recovery operations, removing 1 m^3 to 44 m^3 surface oil, by Day 7.

This capability is ALARP and no further options to increase capability have been adopted.

6.6.3 Containment and recovery – control measure options analysis

6.6.3.1 Alternative control measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Dedicated Response Vessel in region (exclusive to Woodside)	The environmental benefits associated with containment and recovery are described above. The additional environmental benefit obtained from immediate access to this equipment, permitting deployment as soon as conditions became favourable, would result in a negligible environmental benefit – 22.5-67.5 m^3 of oil recovered per operating unit per day.	Chartering and equipping additional vessels on standby has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated effectiveness of dispersant operations to treat the spill which are available from Day 2. The effectiveness of this control (encounter rate, weather dependency, availability) is rated as very low.	The cost (A$15 m per annum for the PAP) and organisational complexity of employing a dedicated response vessel is considered disproportionate to the insignificant environmental benefit to be realised by implementing this control.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Dedicated Response Vessel in region (shared resource)	The environmental benefit would be similar to that described above for Woodside integrated fleet vessels.	Additional containment and recovery resources and capability can be contracted should the need arise.	The cost and complexity of implementing and maintain this alternative control measure is considered high given the predicted effectiveness. Even with consideration of shared costs, the minor benefit of this control measure does not justify the cost.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Regional oil spill response contractor	This option may achieve minor incremental improvements in surface oil and residual oil volumes similar to those described for integrated fleet vessels. However, given the likely vessel transit times involved to/from the offshore spill location, this option is unlikely to realise material environmental benefits additional the capability selected.	No current private response contracting capability exists that would significantly improve response timing or effectiveness in the Dampier or Exmouth regions.	N/A – not currently feasible	This option is not adopted as it is not currently feasible.	No

6.6.3.2 Additional control measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Train additional Woodside personnel in Exmouth to coordinate containment and recovery operations	Limited environmental benefit to be gained by training additional personnel as the number of operations will be governed by the availability of response vessels.	Current capability meets need. Woodside has a pool of trained, competent offshore responders / team leaders at strategic locations to ensure timely and sustainable response. Additional personnel are available through current contracts with AMOSC and OSRL and agreements with AMSA. Marine standards & guidelines ensure vessel masters are competent for their roles. Regular audits of oil spill response organisations ensure training and competency is maintained.	Minor additional cost regarding training and maintenance of competency.	This option is not adopted as the current capability meets the need.	No

6.6.3.3 Improved control measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Prioritise rapid sweep systems (NOFI Buster series, Desmi Speed Sweep, etc.) for mobilisation from service providers	Although each rapid sweep containment and recovery operation could remove an additional 10-45 m^3 per operation per day, the environmental benefit of containment and recovery as a response technique is minor. This response technique is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore. Additionally, surface hydrocarbon concentrations required for effective containment and recovery operations are not predicted to be present during the modelled WCCS (Credible Scenario-01).	Rapid sweep systems allow containment and recovery operations to be undertaken at speeds of up to 3 knots. This allows for greater encounter rates and surface coverage. AMOSC has recently purchased a Speed Sweep system and a number of NOFI systems are available through Mutual Aid arrangements.	Additional costs for prioritising rapid sweep systems are negligible	Although containment and recovery remains a low-efficiency response technique, this control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

Prioritise active booming systems (Ro-skim, etc.) for mobilisation from service providers	Although each active booming system could remove an additional 10-45 m^3 per operation per day, the environmental benefit of containment and recovery as a response technique is minor. This response technique is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore. Additionally, surface hydrocarbon concentrations required for effective containment and recovery operations are not predicted to be present during the modelled WCCS (Credible Scenario-01).	Active booming systems allow containment and recovery operations without the need for an additional skimming system. This allows for greater effectiveness and continued skimming operations. Active booming systems are available through OSRL and Mutual Aid arrangements and would be prioritised for mobilisation.	Additional costs for prioritising active booming systems are negligible	Although containment and recovery remains a low-efficiency response technique, this control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes
Pre-position additional containment and recovery equipment (Exmouth)	It is unlikely that faster mobilisation and deployment from Exmouth would significantly increase response effectiveness or removal of oil to create an increased environmental benefit	Facilities at Exmouth are currently limited by tides and draft for the loading and unloading of vessels with heavy plant and equipment. Access to the Navy Pier to provide an additional loading location is subject to Defence Force approval and cannot be relied upon for rapid approval in the event of an oil spill.	Limited additional cost considerations.	This option is not adopted as the complexity is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No
Re-locate containment and recovery equipment on in-field vessels	The additional environmental benefit obtained from faster mobilisation and deployment would be limited by safety considerations during the initial period following the release. Once operations were considered safe, the vessels would increase recovery capacity to 23-90 m^3/day per operation. The limited oil treatment of containment and recovery and expected effectiveness of dispersant application from vessels indicates the preference would be for greater surface dispersant application capability.	Operations close to the release location are unlikely to be feasible during the initial period due to the uncertainty of the situation and potential safety impacts on personnel. Vessels may require time to return to port and load equipment, fuel etc. to allow response duration to be the maximum possible once deployed. Shortening the timeframes for vessel availability would require equipment to be pre-positioned on-board vessels.	The cost and organisational complexity of employing two dedicated response vessels (approximately A$15 m per year per vessel) is considered disproportionate to the limited environmental benefit to be realised by adopting this control	This option is not adopted as the cost is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No
Purchase or pre-position larger skimmers	The environmental benefit of containment and recovery for the loss of well control scenario is minor. This response strategy is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore.	Larger systems such as the Desmi Octopus or Transrec with >200 m^3 per hour capacity, could improve recovery rates, however are not readily available in Australia and not easily compatible with booming, waste and hydraulic power systems. If required and deemed to be of benefit, these systems are available through Service Providers such as OSRL.	Cost of purchasing Octopus system is A$600,000 plus additional transport, training and commissioning costs and ongoing maintenance costs. Cost for pre-positioning in Australia for the life of the asset/activity is greater than the purchase costs.	This option is not adopted as the cost is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No

6.6.4 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - Prioritise rapid sweep systems (NOFI Buster series, Desmi Speed Sweep, etc.) for mobilisation from service providers
  - Prioritise active booming systems (Ro-skim, etc.) for mobilisation from service providers

6.7 Shoreline protection and 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.

6.7.1 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, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.7.2 Response planning: Nganhurra Cessation of Operations – 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 within 24 hours. Modelling scenarios indicate that first shoreline impact will be at Ningaloo Coast North WHA on Day 0.9 (19 m^3) for marine diesel release caused by marine vessel collision (Credible Scenario-06), Ningaloo Coast North on Day 2.25 (0.389 m^3) for marine diesel release caused by marine vessel separation (Credible Scenario-05) and Mangrove Bay on Day 21 (0.882 m^3) for the Nganhurra Cessation of Operations loss of well control scenario (Credible Scenario-01). No shoreline impact is predicted for Credible Scenario-03. The existing capability is considered sufficient to mobilise and deploy protection at all identified RPAs prior to hydrocarbon contact. In the event of a real spill, protection activities will be guided by predictive modelling, direct observation/surveillance and remote sensing methods (OM01, OM02 and OM03) which will be 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). OM04 would only be undertaken in liaison with WA DoT. Due to potentially high levels of volatiles from a spill of marine diesel, shoreline protection and deflection operations would only be undertaken if safety of responders could be ensured.

TRPs exist for many of the RPAs identified. The plans identify values and sensitivities that would be protected at each location. Modelling does not predict that all priority protection shorelines will be at risk of contact at the same time. Therefore, to allow for the best use of available shoreline protection and deflection resources, operational monitoring (OM01, OM02 and OM03) will inform the response, targeting RPAs where contact is predicted. Table 6-14 below outlines the capability required (number of RPAs predicted to be impacted) against the capability available (number of shoreline protection and deflection operations that can be mobilised and deployed). As can be seen from the table below. Woodside's capability exceeds the response planning need identified for shoreline protection and deflection operations at identified RPAs.

Table 6-14: Response planning – shoreline protection and deflection

	Shoreline Protection & Deflection	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															
A	Capability Required															
A1	Number of RPAs contacted (> 100g/m^2) – Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01)	0	0	0	0	0	0	0		0	1	0		7	5	2
A2	Number of RPAs contacted (> 100g/m^2) – Nganhurra Cessation of Operations marine diesel release caused by marine vessel separation (Credible Scenario-05)	0	1	0	2	0	0	0		0	0	0		0	0	0
A3	Number of RPAs contacted (> 100g/m^2) – Nganhurra Cessation of Operations marine diesel release caused by marine vessel collision (Credible Scenario-06)	1	1	0	0	0	0	0		0	0	0		0	0	0
B	Capability Available (operations per day)															
B1	SPD operations available – per day (lower)	1	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 and A2 – the number of Response Protection Areas contacted by surface hydrocarbons above 100 g/m^2

B1 and B2 – the upper and lower number of shoreline protection and deflection operations available (based on response planning assumptions in Section 5.7),

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

Table 6-15: RPAs for Nganhurra Cessation of Operations facility operations loss of well control scenario (Credible Scenario-01), accidental removal of the xmas tree with an ongoing leak scenario (Credible Scenario-03), release caused by marine vessel separation (Credible Scenario-05) and release caused by marine vessel collision (Credible Scenario-06)

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
Yardie Creek	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	45.75 days (6.00 m^3)	10.02 m^3 (day 53.75)	No contact	N/A	N/A	No contact	No contact	No contact
Turquoise Bay			44.5 days (8.317 m^3)	8.57 m^3 (day 87.5)	No contact	N/A	N/A	No contact	No contact	No contact
Mangrove Bay			21.0 days (0.882 m^3)	12.6 m^3 (day 52.25)	No contact	N/A	N/A	No contact	No contact	No contact
Jurabi-Lighthouse Beaches			40.5 days (410.27m^3)	410.27 m^3 (day 40.5)	No contact	N/A	N/A	No contact	No contact	No contact
Ningaloo Coast North and WHA	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	N/A	N/A	No contact	2.25 days (0.389 m^3)	197.4 m^3 (3.75 days)	No contact	22 hours (0.9 days) (19 m^3)	139 m^3 (day 2)
Ningaloo Coast Middle	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	N/A	N/A	No contact	3.5 days (0.08 m^3)	2.58 m^3 (4.25 days)	No contact	No contact at threshold	No contact at threshold
Shark Bay	State Marine Park	IUCN VI – Multiple Use Zone	58.5 days (215.22m^3)	215.22 m^3 (day 58.5)	No contact	No contact	No contact	No contact	No contact	No contact

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
	Australian Marine Park World Heritage Area									
Montebello Islands	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN – II and IV Recreational Use Zone IUCN II – Marine National Park Zone	60.0 days (4.46 m^3)	33.14 m^3 (day 81.25)	No contact	No contact	No contact	No contact	No contact	No contact
Barrow Island	Barrow Island Marine Park Barrow Island Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN IV – Recreational Use Zone	54.0 days (6.855 m^3)	514.44 m^3 (day 81.5)	No contact	No contact	No contact	No contact	No contact	No contact
Abrolhos Islands	Abrolhos Islands	IUCN II – Marine	61.5 days (4.91 m^3)	4.91 m^3 (day 61.5)	No contact	No contact	No contact	No contact	No contact	No contact

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
	Australian Marine Park	National Park Zone IUCN VI – Multiple Use Zone IUCN IV – Recreational Use Zone								
Muiron Islands	Murion Islands Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	41.0 days (133.98m^3)	133.98 m^3 (day 41.00)	No contact	4.5 days (0.04 m^3)	37.98 m^3 (6 days)	No contact	No contact	No contact
Southern Islands Group	State Nature Reserve	IUCN VI - Multiple Use Zone	40.25 days (0.88 m^3)	134.13 m^3 (day 90.25)	No contact	No contact	No contact	No contact	No contact	No contact

TRPs that exist for the RPAs identified in Table 6-15 are detailed in Table 6-16.

Table 6-16: Indicative tactical response plan, aims and methods for RPAs with predicted contact

Tactical Response Plan	Response aims and methods
Ningaloo coast – Mangrove Bay	**First Response Aim: Protection of Mangrove Bay Lagoon.** Methods: Prevent oil ingress to lagoons through use of shore sealing booms. Complete northern lagoon first, then southern if required – depending on beach topography and tidal cycle. **Second Response Aim: Pre-clean of the beach area.** Methods: Using rakes and shovels move any debris on the beach to above the high tide area, above the reach of any floating oil. **Third Response Aim: Recovery of oil at lagoon entrance.** Methods: Use skimmer to recover floating oil. **Fourth Response Aim: Clean-up of oiled shoreline.** Methods: Manual clean up techniques, predominantly rakes and shovels, with flushing and vacuum skimming if appropriate and required
Ningaloo coast – Turquoise Bay	**First Response Aim: Pre-clean of the beach area.** Method: Using rakes and shovels move any debris on the beach to above the high tide area, above the reach of any floating oil. **Second Response Aim: Clean-up of oiled shoreline.** Method: Manual clean up techniques, predominantly rakes and shovels, with flushing and vacuum skimming if appropriate and required.
Ningaloo coast – Yardie Creek	**First Response Aim: Protection of Yardie Creek entrance.** Methods: Prevent oil ingress to lagoon through use of shore sealing boom. **Second Response Aim: Pre-clean of the beach area.** Methods: Using rakes and shovels move any debris on the beach to above the high tide area, above the reach of any floating oil. **Third Response Aim: Recovery of oil at Yardie Creek entrance.** Methods: Use skimmer to recover floating oil into temporary storage. **Fourth Response Aim: Clean up of oiled shoreline.** Methods: Manual clean up techniques, predominantly rakes and shovels, with flushing and vacuum skimming if appropriate and required.
Ningaloo coast – Jurabi-Lighthouse Beaches	**First Response Aim: Pre-clean of the beach area.** Method: Using rakes and shovels move any debris on the beach to above the high tide area, above the reach of any floating oil. **Second Response Aim: Clean-up of oiled shoreline.** Method: Manual clean up techniques, predominantly rakes and shovels, with flushing and vacuum skimming if appropriate and required.
Barrow and Lowendal Islands	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas.

Tactical Response Plan	Response aims and methods
	Second response objective: Protection of sensitive areas. Prevent hydrocarbons impact through use of shoreline booms. Areas to protect and formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third response objective**: Pre-clean of potential impact areas (if time allows) using rakes and shovels to move any debris above the high tide line and then segregate appropriately. **Fourth response objective**: Recovery of floating oil where possible through the use of skimming systems and other appropriate recovery devices. Although boom formations will deflect most of the spilt hydrocarbon away from sensitive areas, it may be necessary to collect and remove floating oil from additional boom formations to prevent the spreading of oil down a coastline. **Fifth response objective:** Clean-up of the shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate.
Montebello Island Champagne Bay and Chippendale channel TRP	**First response aim:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas. **Second response aim**: Protection of Champagne Bay. Prevent hydrocarbon passing into the inner reaches of Champagne Bay through use of shoreline booms at Chippendale Channel and the south-western sides of Champagne Bay. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third response aim**: Collection and specialist cleaning/rehabilitation of oiled wildlife.
Montebello Island - Claret Bay TRP	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas. **Second response objective**: Protection of mangrove within Claret Bay through use of shoreline booms. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third response objective**: Clean-up of the shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate.
Montebello Island – Hermite/Delta Island Channel TRP	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas. **Second response objective**: Protection of Mansion Bay. Prevent hydrocarbon passing through the channel into Mansion Bay with the use of shoreline booms. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions.
Montebello Island – Hock Bay TRP	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas. **Second response objective**: Prevent hydrocarbon passing into the inner reaches of Stephenson Channel through use of shoreline booms at Hock Bay. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions.

Tactical Response Plan	Response aims and methods
Montebello Island – North and Kelvin Channel TRP	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas. **Second response objective**: Prevent hydrocarbon passing through North Channel and Kelvin Channel into the inner areas of the Montebellos through use of shoreline booms. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third response objective**: Recovery of floating oil where possible through the use of skimming systems and other appropriate recovery devices. It is necessary to collect and remove floating oil at sea to reduce shoreline impact.
Montebello Island – Sherry Lagoon Entrance TRP	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas. **Second response objective**: Prevent hydrocarbon passing into Sherry Lagoon through use of shoreline booms at the entrance. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions.
Montebello Island – Stephenson Channel Nth TRP	**First response objective:** Ongoing operational monitoring and evaluation of the hydrocarbon spill to adapt aims and response tactics to the evolving nature of the incident and to assist in locating relevant booming areas **Second response objective**: Prevent hydrocarbon passing into the inner reaches of Stephenson Channel through use of shoreline booms. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third response objective**: Recovery of floating oil where possible through the use of skimming systems and other appropriate recovery devices. It is necessary to collect and remove floating oil at sea to reduce shoreline impact.
Shark Bay Area 1: Carnarvon to Wooramel	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of mangrove by deployment of protection boom formations along the shore to reduce oil contact to mangrove community. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Conduct low pressure washing to remove oil accumulation in impacted area in the mangrove. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT.
Shark Bay Area 2: Wooramel to Petite Point	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Prevent hydrocarbon ingress to Area 2 by conducting at sea containment and recovery using skimming systems and other appropriate recovery devices and/or deflecting hydrocarbon slick to Monkey Mia through deployment of deflection booming formations.

Tactical Response Plan	Response aims and methods
	Third Response objective: On water containment and skimming of residual hydrocarbon slick using suitable recovery devices within Hamelin Pool. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT. **Fourth Response objective:** Clean-up the beach. Low pressure washing from shore to avoid agitation of sediment nearshore. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT.
Shark Bay Area 3: Petite Point to Dubaut Point	**First Response Objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Prevent hydrocarbon ingress to Area 3 by conducting at sea containment and recovery using skimming systems and other appropriate recovery devices and/or deflecting hydrocarbon slick to Monkey Mia through deployment of deflection booming formations. **Third Response objective:** Set up booming formations to collect floating oil and minimise area of beach impacted. Formation types to deploy will be dependent on the time available until the hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Low pressure washing from shore to avoid agitation of sediment nearshore.
Shark Bay Area 4: Dubaut Point to Herald Bight	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of shoreline by deployment of protection boom formations along the shore to reduce oil contact to the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of 4WD vehicles to access beaches and locally affected areas.
Shark Bay Area 5: Herald Bight to Eagle Bluff	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of sensitive ecological areas and infrastructures by deployment of protection boom formations along the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels and 4WD vehicles to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT AT SENSITIVE AREAS
Shark Bay Area 6: Eagle Bluff to Useless Loop	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident.

Tactical Response Plan	Response aims and methods
	Second Response objective: Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of sensitive ecological areas and infrastructures by deployment of protection boom formations along the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels and 4WD vehicles to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT AT SENSITIVE AREAS
Shark Bay Area 7: Useless Loop to Cape Bellefin	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of sensitive ecological areas and infrastructures by deployment of protection boom formations along the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels and 4WD vehicles to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT AT SENSITIVE AREAS
Shark Bay Area 8: Cape Bellefin to Steep Point	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of mangrove and turtle nesting beaches by deployment of protection boom formations along the shore to reduce oil contact to shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Conduct low pressure washing to remove oil accumulation in impacted area in the mangrove. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT
Shark Bay Area 9: Western Shores of Edel Land	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Protection of turtle nesting beaches by deployment of protection boom formations along the shore to reduce oil contact to shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Note: This Plan assumes at sea Containment and Recovery in the Indian Ocean is an ongoing response activity.**
Shark Bay Area 10: Dirk Hartog Island	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident.

Tactical Response Plan	Response aims and methods
	Second Response objective: Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Protection of bird and turtle nesting beaches by deployment of protection boom formations along the shore to reduce oil contact to shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Fourth Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels and 4WD vehicles to access beaches and locally affected areas. **Note: This Plan assumes at sea Containment and Recovery in the Indian Ocean is an ongoing response activity.**
Shark Bay Area 11: Bernier and Dorre Islands	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Conduct on water containment and recovery of hydrocarbon slick through the use of skimming systems and other appropriate recovery devices to reduce amount of oil spreading to shoreline. **Third Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT. **Notes:** **1. Due to the sensitivity of the islands, the response aims to minimise responder presence on the islands where possible.** **2. This Plan assumes at sea Containment and Recovery in the Indian Ocean is an ongoing response activity.**
Abrohlos Islands: Pelseart Group	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Protection of sensitive ecological areas and infrastructures by deployment of protection and/or deflection boom formations along the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT AT SENSITIVE AREAS
Abrohlos Islands: Wallabi Group	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Protection of sensitive ecological areas and infrastructures by deployment of protection and/or deflection boom formations along the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions.

Tactical Response Plan	Response aims and methods
	Third Response objective: Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT AT SENSITIVE AREAS
Abrohlos Islands: Easter Group	**First Response objective:** Ongoing operational monitoring and evaluation of hydrocarbon spill to adapt aims and response tactics to evolving nature of the incident. **Second Response objective:** Protection of sensitive ecological areas and infrastructures by deployment of protection and/or deflection boom formations along the shore. Formation types to deploy will be dependent on time available until hydrocarbon impacts the shoreline and local geographical and tidal/weather conditions. **Third Response objective:** Clean-up impacted shoreline. Manual clean up techniques, use of mechanical recovery methods and techniques where appropriate. Use of vessels to access beaches and locally affected areas. OPERATIONAL NEBA REQUIRED PRIOR TO DEPLOYMENT AT SENSITIVE AREAS
Pilbara Islands - Southern Island Group	**First Response objective:** Undertake Monitor and Evaluate strategy – Shoreline assessment techniques to be undertaken. **Second Response objective:** Pre-clean of the beach area using rakes and shovels, move any debris on the beach to above the high tide area, above the reach of any floating oil. **Third Response objective:** Shoreline Protection - prevent oil from moving into key sensitive areas within the gulf area by deployment of booms. Deflection & containment methods would be undertaken. **Fourth Response objective:** Recovery of collected oil where possible through the use of skimming systems. Although boom formations will deflect most of the spilt hydrocarbon away from sensitive areas, it may be necessary to collect and remove floating oil from additional boom formations to prevent the spread of oil down the coastline into the Gulf. **Fifth Response objective:** Clean-up of oiled shoreline using manual clean up techniques, predominantly rakes and shovels, with flushing and vacuum skimming if appropriate and required.

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 any additional TRPs drafted only when operational monitoring (OM02 and OM03) and modelling (OM01) indicate that contact could occur at RPA(s). 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.

6.7.3 Shoreline protection and deflection – control measure options analysis

6.7.3.1 Alternative control measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Pre-position equipment at Response Protection Areas (RPAs)	Additional environmental benefit of having equipment prepositioned is considered minor. Equipment is currently available to 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

6.7.3.2 Additional control measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Supplemented stockpiles of equipment in Exmouth to protect additional shorelines	Additional equipment would increase the number of receptor areas that could be protected from hydrocarbon contact. However, current availability of personnel and equipment is capable of protecting up to 30 km of shoreline, commensurate with the scale and progressive nature of shoreline impact. Additional stocks would be made available from international sources if long term up scaling were necessary. A reduction in environmental consequence from a 'B' rating (serious long-term impacts) is unlikely to be realised as a result of having more equipment available locally.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost for purchase supplemental protection and deflection equipment would be approx. A$455,000 per package.	This option is not adopted as the existing capability meets the need.	No
Additional trained personnel	The level of training and competency of the response personnel ensures the shoreline protection and deflection operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted OSRO's (OSRL/AMOSC) to manage other responders. Response personnel are trained and exercised regularly in shoreline response techniques and methods. All personnel involved in a response will receive a full operational/safety brief prior to commencing operations.	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.7.3.3 Improved control measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Modelling predicts shoreline contact at Ningaloo Coast North WHA on day 1 (19 m^3) for Credible Scenario 06, thus Woodside would expedite 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 12-24 hours of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within 24 hours.	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

6.7.4 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.8 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.

6.8.1 Existing capability – shoreline clean-up

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, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.8.2 Response planning: Nganhurra Cessation of Operations – 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.

Modelling predicts first shoreline impact at Ningaloo Coast North WHA on Day 0.9 (19 m^3) for marine diesel release caused by marine vessel collision (Credible Scenario-06), Ningaloo Coast North on Day 2.25 (0.389 m^3) for marine diesel release caused by marine vessel separation (Credible Scenario-05) and at Mangrove Bay on Day 21 (0.882 m^3) for loss of well control scenario (Credible Scenario-01). The largest volume ashore is 197 m^3 at Ningaloo Coast North on day 3 (Credible Scenario-05) and 889.935 m^3 at Ningaloo Coast (includes Jurabi-Lighthouse Beaches, Turquoise Bay, Mangrove Bay and Yardie Creek) by Day 46.5. This includes 410.273 m^3 (day 40.5 – Lighthouse-Jurabi) and 133.987 m^3 (day 41 – Muiron Islands). 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. No shoreline impact is predicted for Credible Scenario-03.

Table 6-17 shows a deficit of shoreline clean-up operations versus the predicted need for the impact on days 1, 2 and 3 which are related to Credible Scenario-05 and Credible Scenario-06, however, the diesel properties and the expected high level of atmospheric volatiles would likely prohibit immediate commencement of a shoreline clean-up. Additionally, a considerable proportion of the diesel would continue to evaporate even after impact. 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 potentially high levels of volatiles from a spill of marine diesel, SCAT and clean-up operations would only be undertaken if safety of responders could be ensured.

These figures have been combined into a single response planning need scenario that provides a worst-case scenario for planning purposes as outlined below. The control measures selected provide capability to mobilise shoreline clean-up equipment with additional trained personnel from existing labour contracts from day 1. The existing shoreline clean-up capability would be sufficient by day 3. As noted above, for the diesel spill scenarios (Credible Scenario-05 and Credible Scenario-06), the level of volatiles would prohibit the immediate commencement of shoreline clean-up. 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 Exmouth region to undertake clean-up operations and to manage wastes generated during the response effort. From previous assessment of facilities in the Exmouth region, Woodside estimates that current accommodation can cater for a range of 500-700 personnel per day.

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. 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 6.8.3.

Table 6-17: 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	Month 5
	Oil on shoreline (from deterministic modelling) m^3														
	Shoreline accumulation (above 100g/m^2) - m^3	19	139	197	41	0	0	0	0	1	0	579	772	143	0
	Oil remaining following response operations - m^3		10	75	109	60	24	10	0	0	0	0	232	170	-45
A	**Capability Required (number of operations)**														
A1	**Shoreline clean-up operations required (lower)**	2	19	27	15	6	2	1	0	0	0	58	100	31	-4
A2	**Shoreline clean-up operations required (upper)**	3	27	39	21	9	3	1	0	1	0	83	143	45	-6
B	**Capability Available (number of operations)**														
B1	**Shoreline clean-up operations available - Stage 2 - Manual (lower)**	1	16	18	20	23	27	30	210	210	210	840	840	840	840
B2	**Shoreline clean-up operations available - Stage 2 - Manual (upper)**	1	17	20	23	25	30	35	245	245	245	980	980	980	980
C	**Capability Gap**														
C1	**Shoreline clean-up operations gap (lower)**	1	3	9	0	0	0	0	0	0	0	0	0	0	0
C2	**Shoreline clean-up operations gap (upper)**	2	10	19	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 5.8). Negative numbers indicate an exceedance of available capability versus need.

C1 and C2 – the gap between the upper and lower number of shoreline clean-up operations required in A1 and A2 compared to the operations available in B1 and B2

Table 6-18: RPAs for Nganhurra Cessation of Operations facility operations loss of well control scenario (Credible Scenario-01), accidental removal of the xmas tree with an ongoing leak scenario (Credible Scenario-03), release caused by marine vessel separation (Credible Scenario-05) and release caused by marine vessel collision (Credible Scenario-06)

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
Yardie Creek	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	45.75 days (6.00 m^3)	10.02 m^3 (day 53.75)	No contact	N/A	N/A	No contact	No contact	No contact
Turquoise Bay			44.5 days (8.317 m^3)	8.57 m^3 (day 87.5)	No contact	N/A	N/A	No contact	No contact	No contact
Mangrove Bay			21.0 days (0.882 m^3)	12.6 m^3 (day 52.25)	No contact	N/A	N/A	No contact	No contact	No contact
Jurabi-Lighthouse Beaches			40.5 days (410.27m^3)	410.27 m^3 (day 40.5)	No contact	N/A	N/A	No contact	No contact	No contact
Ningaloo Coast North and WHA	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	N/A	N/A	No contact	2.25 days (0.389 m^3)	197.4 m^3 (3.75 days)	No contact	22 hours (0.9 days) (19 m^3)	139 m^3 (day 2)
Ningaloo Coast Middle	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	N/A	N/A	No contact	3.5 days (0.08 m^3)	2.58 m^3 (4.25 days)	No contact	No contact at threshold	No contact at threshold
Shark Bay	State Marine Park Australian Marine Park	IUCN VI – Multiple Use Zone	58.5 days (215.22m^3)	215.22 m^3 (day 58.5)	No contact	No contact	No contact	No contact	No contact	No contact

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
	World Heritage Area									
Montebello Islands	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN – II and IV Recreational Use Zone IUCN II – Marine National Park Zone	60.0 days (4.46 m^3)	33.14 m^3 (day 81.25)	No contact	No contact	No contact	No contact	No contact	No contact
Barrow Island	Barrow Island Marine Park Barrow Island Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN IV – Recreational Use Zone	54.0 days (6.855 m^3)	514.44 m^3 (day 81.5)	No contact	No contact	No contact	No contact	No contact	No contact
Abrolhos Islands	Abrolhos Islands Australian Marine Park	IUCN II – Marine National Park Zone	61.5 days (4.91 m^3)	4.91 m^3 (day 61.5)	No contact	No contact	No contact	No contact	No contact	No contact

Response Protection Areas (RPAs)	Conservation status	IUCN protection category	Credible Scenario-01		Credible Scenario-03		Credible Scenario-05		Credible Scenario-06	
			Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3	Maximum shoreline accumulation (>100g/m^2) in m^3	Minimum time to shoreline contact (>100g/m^2) in days	Maximum shoreline accumulation (>100g/m^2) in m^3
		IUCN VI – Multiple Use Zone IUCN IV – Recreational Use Zone								
Muiron Islands	Murion Islands Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	41.0 days (133.98m^3)	133.98 m^3 (day 41.00)	No contact	4.5 days (0.04 m^3)	37.98 m^3 (6 days)	No contact	No contact	No contact
Southern Islands Group	State Nature Reserve	IUCN VI - Multiple Use Zone	40.25 days (0.88 m^3)	134.13 m^3 (day 90.25)	No contact	No contact	No contact	No contact	No contact	No contact

6.8.3 Shoreline clean-up – control measure options analysis

6.8.3.1 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.					

6.8.3.2 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.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel could be 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 would be adopted if real time operational monitoring determines that an impact is likely above the existing response capability.	Yes
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 $2,000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.8.3.3 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	Modelling predicts shoreline contact at Ningaloo Coast North WHA on day 1 (19 m^3) for Credible-Scenario-06, thus Woodside would expedite deployment of shoreline clean-up using existing capability.	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 12-24 hours of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within 24 hours.	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

		RPAs predicted to be contacted are based on modelling and may differ in a real spill event thus pre-positioning equipment and personnel may provide no additional benefit.			

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
  - Additional trained personnel available (if need is determined by real-time operational monitoring during a spill event).
- Improved
  - None selected

6.9 Waste management – ALARP assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.9.1 Existing capability – waste management

Woodside's 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, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.9.2 Waste management – control measure options analysis

6.9.2.1 Alternative control measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.9.2.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Increased waste storage capability	The procurement of waste storage equipment options on the day of the event will allow immediate response and storage of collected waste. The environmental benefit of immediate waste storage is to reduce ecological consequence by safely securing waste, allowing continuous response operations to occur.	Access to Veolia's storage options provides the resources required to store and transport sufficient waste to meet the need. Access to waste contractors existing facilities enables waste to be stockpiled and gradually processed within the regional waste handling facilities. Additional temporary storage equipment is available through existing contract and arrangements with OSRL. Existing arrangements meet identified need for the PAP.	Cost for increased waste disposal capability would be approx. A$1300 per m^3. Cost for increased onshore temporary waste storage capability would be approx. $40 per unit per day.	This option is not adopted as the existing capability meets the need.	No

6.9.2.3 Improved control measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response time	The access to Veolia waste storage options provides the resources to store and transport waste, permitting the wastes to be stockpiled and gradually processed within the regional waste handling facilities. Bulk transport to Veolia's licensed waste management facilities would be undertaken via controlled-waste-licensed vehicles and in accordance with Environmental Protection (Controlled Waste) Regulations 2004. The environmental benefit from successful waste storage will reduce pressure on the treatment and disposal facilities reducing ecological consequences by safely securing waste. In addition, waste storage and transport will allow continuous response operations to occur. This delivery option would increase known available storage, eliminating the risk of additional resources not being available at the time of the event. However, the environmental benefit of Woodside procuring additional waste storage is considered minor as the risk of additional storage not being available at the time of the event is considered low and existing arrangements provide adequate storage to support the response.	Woodside already maintains an equipment stockpile in Exmouth to enable shorter response times to incidents. This stockpile includes temporary waste storage equipment. Woodside has access to stockpiles of waste storage and equipment in Dampier and Exmouth through existing contracts and arrangements.	The incremental benefit of having a dedicated local Woodside owned stockpile of waste equipment and transport is considered minor and cost is considered disproportionate to the benefit gained given predicted shoreline contact times.	This option is not adopted as the existing capability meets the need.	No

6.9.3 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.10 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.

6.10.1 Existing capability – wildlife response

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, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.10.2 Oiled wildlife response – control measure options analysis

6.10.2.1 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

6.10.2.2 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.	Given the low likelihood of such an event occurring and the low environmental benefit of an offshore response, the cost of implementing measures to reduce the mobilisation time is considered disproportionate to the benefit. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. Oiled wildlife response capacity would be addressed for open Commonwealth waters through the AMOSC arrangements, as informed by operational monitoring. The cost and organisational complexity of this approach is moderate, and the overall delivery effectiveness is high.	Additional wildlife response resources could total A$1700 per operational site per day.	This option is not adopted as the existing capability meets the need.	No
Additional trained wildlife responders	Current numbers meet the needs required and additional personnel are available through existing contracts with oil spill response organisations and environmental panel contractors. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. The potential environmental benefit of training additional personnel is expected to be low.	The capability provides the capacity to treat approximately 600 wildlife units (primarily avian wildlife) by Day 6, with additional capacity available from OSRL. Additional equipment and facilities would be required to support ongoing response, depending on the scale of the event and the impact to wildlife. Materials for holding facilities, portable pools, enclosures and rehabilitation areas would be sourced as required.	Additional wildlife response personnel cost A$2000 per person per day	This option is not adopted as the existing capability meets the need.	No

6.10.2.3 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, RPAs predicted to be contacted are based on modelling data and may differ in a real spill event thus pre-positioning equipment and personnel may provide no additional 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 2-3 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, however, considered disproportionate to the environmental benefit.	This option is not adopted as the existing capability meets the need.	No

6.10.3 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.11 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.

6.11.1 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.

6.11.2 Scientific Monitoring – Control Measure Options Analysis

Table 6-19: 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 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 6-20: 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 control 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 control 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 control from the PAP activities.

6.11.3 Improved Control Measures

Improved Control Measures considered – no reasonably practicable improved Control Measures identified.

6.11.4 Selected Control Measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected.
- Additional
  - Determine baseline data needs and activate SMPs for any identified PBAs in the event of an unplanned hydrocarbon release.
- Improved
  - None Selected.

6.11.5 Operational Plan

Key actions from the Scientific Monitoring Program Operational Plan for implementing the response are outlined in Table 6-21: Scientific monitoring program operational plan actions.

Table 6-21: Scientific monitoring program operational plan actions

Responsibility	Action
Activation	
Perth ICC Planning (ICC Planning – Environment Unit)	Mobilises Chief Environmental Scientist or 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 assesses all outputs from OM01, OM02 and OM03 (Section 5 and ANNEX B) 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 SMP standby contractor as 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. Determines practicable baseline acquisition program based on predicted timescales to contact and anticipated SMP mobilisation times. Determines scope for preliminary post-contact surveys during the Response Phase. Determines 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 IMT.
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.

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 SMP 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 standby contactor SMP Manager, SMP Team Leads and Operations Point Coordinator.
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 Jacob's SMP Manager. Agree SMP mobilisation timeline and induction procedures with the Division and Sector Command Point(s).
Perth ICC Logistics	Coordinate with SMP standby contactor SMP 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 Sector Command point(s).

6.11.6 ALARP and Acceptability Summary

ALARP and Acceptability Summary		
Scientific Monitoring		
ALARP Summary	X	All known reasonably practicable control measures have been adopted
	X	No additional, alternative and improved control measures would provide further benefit
	X	No reasonably practical additional, alternative, and/or improved control measure exists
	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.	
Acceptability Summary	• 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 control. • 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.	
On the basis from the impact assessment above and in Section 7 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.		

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:

- *vessel operations and anchoring*
- *distribution of entrained hydrocarbons*
- *toxicity of dispersant*
- *presence of personnel on the shoreline*
- *human presence (manual cleaning)*
- *drill cuttings and drilling fluids environmental impact assessment for relief well drilling*
- *waste generation*
- *additional stress or injury caused to wildlife.*

7.2 Analysis of impacts and risks from implementing response techniques

The table below compares the adopted control measures for this activity against the environmental values that can be affected when they are implemented.

Table 7-1: Analysis of risks and impacts

	Environmental Value						
	Soil & Groundwater	Marine Sediment Quality	Water Quality	Air Quality	Ecosystems/ Habitat	Species	Socio-Economic
Monitor and evaluate		✓	✓		✓	✓	
Source control		✓	✓	✓	✓	✓	✓
Subsea Dispersant Injection		✓	✓		✓	✓	✓
Surface Dispersant Application			✓		✓	✓	✓
Containment and Recovery			✓		✓	✓	✓
Shoreline Protection & Deflection	✓	✓	✓		✓	✓	✓
Shoreline Clean-up	✓	✓	✓		✓	✓	✓
Oiled Wildlife					✓	✓	
Scientific Monitoring	✓	✓	✓	✓	✓	✓	✓
Waste Management	✓			✓	✓	✓	✓

7.3 Evaluation of impacts and risks from implementing response techniques

Vessel operations and anchoring

Typical booms used in containment and recovery operations are designed to float, meaning that fauna capable of diving, such as cetaceans, marine turtles and sea snakes can readily avoid contact with the boom. Impacts to species that inhabit the water column such as sharks, rays and fish are not expected. Additionally, some fauna, such as cetaceans, are likely to detect and avoid the spill area, and are not expected to be present in the proximity of containment and recovery operations.

During the implementation of response techniques, where water depths allow, it is possible that response vessels will be required to anchor (e.g. during shoreline surveys). The use of vessel anchoring will be minimal and likely to occur when the impacted shoreline is inaccessible via road. Anchoring in the nearshore environment of sensitive receptor locations will have the potential to impact coral reef, seagrass beds and other benthic communities in these areas. Recovery of benthic communities from anchor damage depends on the size of anchor and frequency of anchoring. Impacts would be highly localised (restricted to the footprint of the vessel anchor and chain) and temporary, with full recovery expected.

Distribution of entrained hydrocarbons

Surface dispersant application is intended to treat floating hydrocarbons, thereby reducing the risk of air breathing marine fauna (e.g. cetaceans, dugongs, marine turtles, seabirds and shorebirds) from becoming oiled. It also has the potential to reduce/eliminate contamination of sensitive intertidal habitats such as mangroves, coral reefs, salt marshes and sandy shores (recreational and tourist areas) through the reduction in shoreline loadings.

Chemical dispersants act to break up hydrocarbons by reducing surface tension between the oil and the surrounding water. Dispersants, whether applied on the surface or subsea, result in the breakup of hydrocarbons into micron-sized droplets, which are easier to disperse throughout the water column.

These small, dispersed hydrocarbons droplets are degraded by bacteria due to the increased surface area presented by the small droplets. The application of dispersants can enhance biodegradation and dissolution, reducing the volume of hydrocarbons that have the potential to impact shorelines.

Surface application of dispersants results in the micron-sized droplets being mixed into the upper layer of the water column, usually the first 10 to 20 m, through wave and wind energy. These elevated concentrations of dispersed hydrocarbons within the upper layer of the water column are rapidly diluted through vertical and horizontal mixing. The application of surface dispersants may result in a greater risk that water column and subtidal habitats could be exposed to elevated concentrations of dispersed hydrocarbons.

Toxicity of dispersants

The evaluation of the potential impacts to the receiving environment needs to consider not only the redistribution of hydrocarbons into the water column, but also the potential toxic nature of the dispersant applied and the toxicity effects of dispersed hydrocarbons.

The potential toxicity to the marine environment can be from the chemical/dispersant itself but also chemical dispersion of hydrocarbon can increase the concentration of toxic hydrocarbon compounds in the water column (Anderson et al 2014). Subtidal habitats and communities such as coral reefs, seagrass meadows, plankton, fish, known spawning grounds and periods of increased reproductive outputs (early life stages of fish and invertebrates i.e. meroplankton) are susceptible to toxic effects of chemically dispersed hydrocarbons.

Presence of personnel on the shoreline

Presence of personnel on the shoreline during shoreline operations could potentially result in disturbance to wildlife and habitats. During the implementation of response techniques, it is possible that personnel may have minimal, localised impacts on habitats, wildlife and coastlines. The impacts associated with human presence on shorelines during shoreline surveys and response operations may include:

- damage to vegetation/habitat 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.

Human presence

Human presence for manual clean-up operations may lead to the compaction of sediments and damage to the existing environment especially in sensitive locations such as mangroves and turtle nesting beaches. However, any impacts are expected to be localised with full recovery expected.

Drill cuttings and drilling fluids environmental impact assessment for relief well drilling

The identified potential impacts associated with the discharge of drill cuttings and fluids during a relief well drilling activity include a localised reduction in water and seabed sediment quality, and potential localised changes to benthic biota (habitats and communities).

A number of direct and indirect ecological impact pathways are identified for drill cuttings and drilling fluids as follows:

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

Potential impacts from the discharge of cuttings range from the complete burial of benthic biota in the immediate vicinity of the well site due to sediment deposition, smothering effects from raised sedimentation concentrations as a result of elevated TSS, changes to the physico-chemical properties of the seabed sediments (particle size distribution and potential for reduction in oxygen levels within the surface sediments due to organic matter degradation by aerobic bacteria) and subsequent changes to the composition of infauna communities to minor sediment loading above background and no associated ecological effects. Predicted impacts are generally confined to within a few hundred metres of the discharge point (International Association of Oil and Gas Producers 2016) (i.e. within the EMBA for a hydrocarbon spill event).

The discharge of drill cuttings and unrecoverable fluids from relief well drilling is expected to increase turbidity and TSS levels in the water column, leading to an increased sedimentation rate above ambient levels associated with the settlement of suspended sediment particles in close proximity to the seabed or below sea surface, depending on location of discharge. Cuttings with retained (unrecoverable) drilling fluids are discharged below the water line at the MODU location, resulting in drill cuttings and drilling fluids rapidly diluting, as they disperse and settle through the water column. The dispersion and fate of the cuttings is determined by particle size and density of the retained (unrecoverable) drilling fluids, therefore, the sediment particles will primarily settle in proximity to the well locations with potential for localised spread downstream (depending on the speed of currents throughout the water column and seabed) (IOGP 2016). The finer particles will remain in suspension and will be transported further before settling on the seabed.

These conclusions were supported by discharge modelling which was undertaken by Woodside in support of the Greater Enfield Development EP. Modelling results indicating that the TSS plume of suspended cuttings will typically disperse to the south-west while oscillating with the tide and diminish rapidly with increasing distance from the well locations. Maximum TSS concentrations predicted for 100 m; 250 m and 1 km distances from the wellsite were 7, 5 and 1 mg/L, respectively. Furthermore, water column concentrations below 10 mg/L remain within 235 m of the discharge location for each modelled well. For all well discharge locations (outside of direct discharge sites), TSS concentration did not exceed 10 mg/l. Nelson et al. (2016) identified <10 mg/L as a no effect or sub-lethal minimal effect concentration.

The low sensitivity of the deep-water benthic communities/habitats within and in the vicinity of relief well locations, combined with the relatively low toxicity of WBM and NWBMs, 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 LOC event a relief well drilling activity would be responding too).

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 containment and recovery and shoreline clean-up operations
- semi-solids/solids (oily solids), collected during containment and recovery and shoreline clean-up operations
- debris (e.g. seaweed, sand, woods, plastics), collected during containment and recovery and 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.

Additional stress or injury caused to wildlife

Additional stress or injury to wildlife could be caused through the following phases of a response:

- capturing wildlife
- transporting wildlife
- stabilisation of wildlife
- cleaning and rinsing of oiled wildlife
- rehabilitation (e.g. diet, cage size, housing density)
- release of treated wildlife,

Inefficient capture techniques have the potential to cause undue stress, exhaustion or injury to wildlife, additionally pre-emptive capture could cause undue stress and impacts to wildlife when there are uncertainties in the forecast trajectory of the spill. During the transportation and stabilisation phases there is the potential for additional thermoregulation stress on captured wildlife. Additionally, during the cleaning process, it is important personnel undertaking the tasks are familiar with the relevant techniques to ensure that further injury and the removal of water proofing feathers are managed and mitigated. Finally, during the release phase, it is important that wildlife is not released back into a contaminated environment.

7.4 Treatment of impacts and risks from implementing response techniques

In respect of the impacts and risks assessed the following treatment measures have been adopted. It must be recognised that this environmental assessment is seeking to identify how to maintain the level of impact and risks at levels that are ALARP and of an acceptable level rather than exploring further impact and risk reduction. It is for this reason that the treatment measures identified in this assessment will be captured in Operational Plans, TRPs, and/or the FSP.

Vessel operations and access in the nearshore environment

- The boom will be monitored and maintained to ensure trapped fauna are released as early as possible, with Containment and Recovery activities occurring in daylight hours only (PS 21.1).
- If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified (PS 21.2, 24.1, 27.1).
- Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines (PS 24.2, 27.2).

Distribution of entrained hydrocarbons

- Only apply surface dispersants within the ZoA and on BAOAC 4 and 5 (PS 17.4)
- Continuous monitoring of dispersed oil plume and visual monitoring of effectiveness (PS 17.5)

Toxicity of dispersants

- OSCA approved dispersants prioritised for surface and subsea use (PS 17.3)

Presence of personnel on the shoreline

- Oversight by trained personnel who are aware of the risks (PS 27.6)
- Trained unit leader's brief personnel of the risks prior to operations (PS 27.7)

Human Presence

- 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)
- Vehicular access will be restricted on dunes, turtle nesting beaches and in mangroves (PS 27.3)

Waste generation

- All shorelines zoned and marked before clean-up operations commence to prevent secondary contamination and minimise the mixing of clean and oiled sediment and shoreline substrates (PS 25.5)
- Removal of vegetation will be limited to moderately or heavily oiled vegetation (PS 27.5)

Additional stress or injury caused to wildlife

- Operations conducted with advice from the DBCA Oiled Wildlife Advisor and in accordance with the processes and methodologies described in the WA OWRP and the relevant regional plan (PS 30.3)

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 have been determined to be clearly disproportionate to the environmental benefit gained from its adoption it has been rejected. Where this is not considered to be the case the control measure has been adopted.

The risks from a hydrocarbon spill have been reduced to ALARP because:

- Woodside has a significant hydrocarbon spill response capability to respond to the WCCS through the control measures identified
- new and modified impacts and risks associated with implementing response techniques have been considered and will not increase the risks associated with the activity
- a consideration of alternative, additional, and improved control measures identified any other control measures that delivered proportionate environmental benefit compared to the cost of adoption for this activity ensuring that:
    - all known, reasonably practicable control measures have been adopted
    - no additional, reasonably practicable alternative and/or improved control measures would provide further environmental benefit
    - no reasonably practical additional, alternative, and/or improved control measure exists.
- a structured process for considering alternative, additional, and improved control measures was completed for each control measure
- the evaluation was undertaken based on the outputs of the WCCS so that the capability in place is sufficient for all other scenarios from this activity
- the likelihood of the WCCS spill has been ignored in evaluating what was reasonably practicable.

9 ACCEPTABILITY CONCLUSION

Following the ALARP evaluation process, Woodside deems 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. MARPOL, the World Heritage Convention, the Ramsar Convention, and the Biodiversity Convention etc.). In addition to these, other non-legislative requirements met include:
    - Australian IUCN reserve management principles for Commonwealth marine protected areas and bioregional marine plans
    - National Water Quality Management Strategy and supporting guidelines for marine water quality)
    - conditions of approval set under other legislation
    - national and international requirements for managing pollution from ships
    - national biosecurity requirements.
- Industry standards, best practices and widely adopted standards and other published materials have been used and referenced when defining acceptable levels. Where these are inconsistent with mandatory/ legislative regulations, explanation has been provided for the proposed deviation. Any deviation produces the same or a better level of environmental performance (or outcome).

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11 GLOSSARY & ABBREVIATIONS

11.1 Glossary

Term	Description / Definition
ALARP	Demonstration through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce risks further.
Availability	The availability of a control measure is the percentage of time that it is capable of performing its function (operating time plus standby time) divided by the total period (whether in service or not). In other words, it is the probability that the control has not failed or is undergoing a maintenance or repair function when it needs to be used.
Control	The means by which risk from events is eliminated or minimised.
Control effectiveness	A measure of how well the control measures perform their required function.
Control measure (risk control measure)	The features that eliminate, prevent, reduce or mitigate the risk to environment associated with PAP.
Credible spill scenario	A spill considered by Woodside as representative of maximum volume and characteristics of a spill that could occur as part of the PAP.
Dependency	The degree of reliance on other systems in order for the control measure to be able to perform its intended function.
Environment that may be affected	The summary of quantitative modelling where the marine environment could be exposed to hydrocarbons levels exceeding hydrocarbon threshold concentrations.
Incident	An event where a release of energy resulted in or had (with) the potential to cause injury, ill health, damage to the environment, damage to equipment or assets or company reputation.
Major Environment Event	The events with potential environment, reputation, social or cultural consequences of category C or higher (as per Woodside's operational risk matrix) which are evaluated against credible worst-case scenarios which may occur when all controls are absent or have failed.
Performance outcome	A statement of the overall goal or outcome to be achieved by a control measure
Performance standard	The parameters against which [risk] controls are assessed to ensure they reduce risk to ALARP. A statement of the key requirements (indicators) that the control measure has to achieve in order to perform as intended in relation to its functionality, availability, reliability, survivability and dependencies.
Preparedness	Measures taken before an incident in order to improve the effectiveness of a response
Reasonably practicable	... a computation ... made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) [showing whether or not] that there is a gross disproportion between them ... made by the owner at a point of time anterior to the accident. (Judgement: Edwards v National Coal Board [1949])
Receptors at risk	Physical, biological and social resources identified as at risk from hydrocarbon contact using oil spill modelling predictions.
Receptor areas	Geographically referenced areas such as bays, islands, coastlines and/or protected area (WHA, Commonwealth or State marine reserve or park) containing one or more receptor type.
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.

Term	Description / Definition
Regulator	NOPSEMA are the Environment Regulator under the Environment Regulations.
Reliability	The probability that at any point in time a control measure will operate correctly for a further specified length of time.
Response technique	The key priorities and objectives to be achieved by the response plan Measures taken in response to an event to reduce or prevent adverse consequences.
Survivability	Whether or not a control measure is able to survive a potentially damaging event is relevant for all control measures that are required to function after an incident has occurred.
Threshold	Hydrocarbon threshold concentrations applied to the risk assessment to evaluate hydrocarbon spills.
Zone of Application	The zone in which Woodside may elect to apply dispersant. The zone is determined based on a range of considerations, such as hydrocarbon characteristics, weathering and metocean conditions. The zone is a key consideration in the Net Environmental Benefit Analysis for dispersant use.

11.2 Abbreviations

Abbreviation	Meaning
AIIMS	Australasian Inter-Service Incident Management System
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
BAOAC	Bonn Agreement Oil Appearance Code
BOP	Blowout Preventer
CSt	Centistokes
CICC	Corporate Incident Coordination Centre
DM	Duty Manager
DBCA	Western Australia Department of Biodiversity, Conservation and Attractions (former Western Australian Department of Parks and Wildlife)
EDP	Emergency Disconnect Package
EMBA	Environment that May Be Affected
EMSA	European Maritime Safety Agency
EP	Environment Plan
Environment Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
ESI	Environmental Sensitivity Index
ESD	Environmentally Sustainable Development
ESP	Environmental Services Panel
FPSO	Floating Production Storage Offloading
FSP	First Strike Plan
GIS	Geographic Information System
IAP	Incident Action Plan
IAR	Integrated Artificial Reef
ICC	Incident Coordination Centre
IMT	Incident Management Team
IPIECA	International Petroleum Industry Environment Conservation Association
ISV	Infield support vessel
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
KBSF	King Bay Support Facility
LEL	Lower explosive limit
LMR	Lower Marine Riser
LWI	Light Well Intervention
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding

Abbreviation	Meaning
NEBA	Net Environmental Benefit Analysis
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
OILMAP	Oil Spill Model and Response System
OPEA	Oil Pollution Emergency Arrangements
OPEP	Oil Pollution Emergency Plan
OSCA	Oil Spill Cleaning Agent (registered for use within the National Plan)
OSRL	Oil Spill Response Limited
OSTM	Oil Spill Trajectory Modelling
OWRP	Oiled Wildlife Response Plan
OWROP	Regional Oiled Wildlife Response Operational Plan
OXT	Open water Xmas Tree
PAP	Petroleum Activities Program
PBA	Pre-emptive Baseline Areas
PPB	Parts per billion
PPM	Parts per million
ROV	Remotely Operated Vehicle(s)
RPA	Response Protection Area
S&EM	Security & Emergency Management
SCAT	Shoreline Clean-up Assessment Technique
SDA	Surface Dispersant Application
SIMAP	Integrated Oil Spill Impact Model System
SSDI	Subsea Dispersant Injection
SFRT	Subsea First Response Toolkit
SMP	Scientific monitoring program
TRP	Tactical Response Plan
TSS	Total suspended solids
VXT	Vertical Xmas Tree
WA DoT	Western Australia Department of Transport
WHA	World Heritage Area
Woodside	Woodside Energy Limited
WWCI	Wild Well Control Inc
WCCS	Worst Case Credible Scenario
ZoA	Zone of Application

ANNEX A: NET ENVIRONMENTAL BENEFIT ANALYSIS DETAILED OUTCOMES

A NEBA has 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 subsea loss of well containment of Enfield Crude (Credible Scenario-01) and a surface hydrocarbon release due to a support vessel tank rupture of marine diesel (Credible Scenario-05). The complete list of potential receptor locations within the EMBA within the PAP is included in Section 6 of the EP.

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 (100 g/m^2) at any time

The detailed NEBA assessment outcomes are shown below.

Table A-1: NEBA assessment technique recommendations for Enfield crude – Nganhurra Cessation of Operations loss of well containment (Credible Scenario-01)

Receptor	Monitor and Evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and Recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response
Open Ocean	Yes	Yes	N/A	Yes	Potentially	No	No	Potentially	No	No	No	No	Yes
Jurabi-Lighthouse Beaches	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Turquoise Bay	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Mangrove Bay	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Yardie Creek	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Shark Bay	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Montebello Islands	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Barrow Island	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Pilbara Islands (Southern Group)	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Abrolhos Islands	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes
Muiron Islands	Yes	No	N/A	No	No	No	No	Potentially	Yes	Yes	Potentially	No	Yes

Overall assessment

Sensitive receptor (Sites identified in EP)	Monitor and Evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and Recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response
Is this response Practicable?	Yes	Yes	N/A	Yes	Potentially	No	No	Potentially	Yes	Yes	Potentially	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	Yes	N/A	Yes	Potentially	No	No	Potentially	Yes	Yes	Potentially	No	Yes

Table A-2: NEBA assessment technique recommendations for Enfield crude – Nganhurra Cessation of Operations ongoing leak (Credible Scenario-03)

Receptor	Monitor and Evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and Recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response
Open Ocean	Yes	Yes	N/A	No	No	No	No	No	Yes	Yes	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	Yes	Yes	No	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	Yes	N/A	No	No	No	No	No	Yes	Yes	No	No	Yes

Table A-3: NEBA assessment technique recommendations for surface hydrocarbon release due to a support vessel tank rupture of marine diesel (Credible Scenario-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
Ningaloo Coast North	Yes	N/A	Yes	No	No	No	No	No	Potentially	Potentially	No	No	Yes
Ningaloo Coast Middle	Yes	N/A	Yes	No	No	No	No	No	Potentially	Potentially	No	No	Yes
Muiron Islands	Yes	N/A	Yes	No	No	No	No	No	Potentially	Potentially	No	No	Yes
Open ocean	Yes	N/A	Yes	No	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	No	No	No	No	No	Potentially	Potentially	No	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	N/A	Yes	No	No	No	No	No	Potentially	Potentially	No	No	Yes

Table A-4: NEBA assessment technique recommendations for surface hydrocarbon release of marine diesel due to a vessel collision (Credible Scenario-06)

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
Ningaloo Coast North	Yes	N/A	Yes	No	No	No	No	No	Yes	Yes	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	No	No	No	No	No	Yes	Yes	No	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	N/A	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes

NEBA Impact Ranking Classification Guidance

To reduce variability between assessments, the following ranking descriptions have been devised to guide the workshop process:

			Degree of impact	Potential duration of impact	Equivalent Woodside Corporate Risk Matrix Consequence Level
Positive	3P	Major	Likely to prevent: • behavioural impact to biological receptors • behavioural impact to socio-economic receptors e.g. changes to day-today business operations, public opinion/behaviours (e.g. avoidance of amenities such as beaches) or regulatory designations.	Decrease in duration of impact by > 5 years	N/A
	2P	Moderate	Likely to prevent: • significant impact to a single phase of reproductive cycle of biological receptors • detectable financial impact, either directly (e.g. loss of income) or indirectly (e.g. via public perception), for socio-economic receptors.	Decrease in duration of impact by 1–5 years	N/A
	1P	Minor	Likely to prevent impacts on: • significant proportion of population or breeding stages of biological receptors • socio-economic receptors such as: ○ significant impact to the sensitivity of protective designation; or ○ significant and long-term impact to business/industry.	Decrease in duration of impact by several seasons (< 1 year)	N/A
	0	Non-mitigated spill impact	**No detectable difference to unmitigated spill scenario.**		
Negative	1N	Minor	Likely to result in: • behavioural impact to biological receptors • behavioural impact to socio-economic receptors e.g. changes to day-to-day business operations, public opinion/behaviours (e.g. avoidance of amenities such as beaches), or regulatory designations. **[Note 1]**	Increase in duration of impact by several seasons (< 1 year)	Increase in risk by one sub-category, without changing category (e.g. Minor (E) to Minor (D))
	2N	Moderate	Likely to result in: • significant impact to a single phase of reproductive cycle for biological receptors; or • detectable financial impact, either directly (e.g. loss of income) or indirectly (e.g. via public perception), for socio-economic receptors. This level of negative impact is recoverable and unlikely to result in closure of business/industry in the region.	Increase in duration of impact by 1–5 years	Increase in risk by one category (e.g. Minor (D) to Moderate (C or B))
	3N	Major	Likely to result in impacts on: • significant proportion of population or breeding stages of biological receptors • socio-economic receptors resulting in either: ○ significant impact to the sensitivity of protective designation; or ○ significant and long-term impact to business/industry.	Increase in duration of impact by > 5 years or unrecoverable	Increase in risk by two categories (e.g. Minor (E) to Major (A))

NOTE: the maximum likely impact should be considered; for example, if a spill were to directly impact the behaviour that results in an impact to reproduction and/or the breeding population (such as fish failing to aggregate to spawn), then the score should be a 2 or 3 rather than a 1. Similarly, if a change in behaviour resulted in an increased risk of mortality of a population, then it should be scored as a 2 or 3.

ANNEX B: OPERATIONAL MONITORING ACTIVATION AND TERMINATION CRITERIA

Table B-1: Operational monitoring objectives, triggers and termination criteria

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 1 (OM01) Predictive Modelling of Hydrocarbons to Assess Resources at Risk	OM01 focuses on the conditions that have prevailed since a spill commenced, as well as those that are forecasted in the short term (1–3 days ahead) and longer term. OM01 utilises computer-based forecasting methods to predict hydrocarbon spill movement and guide the management and execution of spill response operations to maximise the protection of environmental resources at risk. The objectives of OM01 are to: • Provide forecasting of the movement and weathering of spilled hydrocarbons • Identify resources that are potentially at risk of contamination • Provide simulations showing the outcome of alternative response options (booming patterns etc.) to inform on-going Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP	OM01 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM01 are: • The hydrocarbon discharge has ceased and no further surface oil is visible • Response activities have ceased • Hydrocarbon spill modelling (as verified by OM02 surveillance observations) predicts no additional natural resources will be impacted

Operational Monitoring <u>Operational Plan</u>	Objectives	Activation triggers	Termination criteria
<u>Operational Monitoring Operational Plan 2 (OM02)</u> 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

<table>
<tr><th>Operational Monitoring <u>Operational Plan</u></th><th>Objectives</th><th>Activation triggers</th><th>Termination criteria</th></tr>
<tr><td><u>Operational Monitoring Operational Plan 3 (OM03)</u>
Monitoring of hydrocarbon presence, properties, behaviour and weathering in water</td><td>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.</td><td>OM03 will be triggered immediately following a level 2/3 hydrocarbon spill.</td><td>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.</td></tr>
<tr><td><u>Operational Monitoring Operational Plan 4 (OM04)</u>
Pre-emptive assessment of sensitive receptors at risk</td><td>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).</td><td>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)</td><td>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)</td></tr>
</table>

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational monitoring operational plan 5 (OM05) Monitoring of contaminated resources	OM05 aims to implement surveys to assess the condition of wildlife and habitats contacted by hydrocarbons at sensitive habitat and shoreline locations. The primary objectives of OM05 are: • Record evidence of oiled wildlife (mortalities, sub-lethal impacts, number, extent, location) and habitats (mortalities, sub-lethal impacts, type, extent of cover, area, hydrocarbon character, thickness, mass and content) throughout the response and clean-up at locations contacted by hydrocarbons to inform and prioritise clean-up efforts and resources, while minimising the potential impacts of these activities. Indirectly, the information collected by OM05 may also support the assessment of environmental impacts, as determined through subsequent SMPs. OM05 would be undertaken in liaison with WA DoT as the control agency once the oil is in State Waters (if a Level 2/3 incident).	OM05 will be triggered when a sensitive habitat or shoreline is predicted to be contacted by hydrocarbons by OM01, OM02 and/or OM03.	The criteria for the termination of OM05 at any given location are: • No additional response or clean-up of wildlife or habitats is predicted • Spill response and clean-up activities have ceased OM05 survey sites established at sensitive habitat and shoreline locations will continue to be monitored during SM02. The formal transition from OM05 to SM02 will begin on cessation of spill response and clean-up activities.

ANNEX C: OIL SPILL SCIENTIFIC MONITORING PROGRAM

Oil Spill Environmental Monitoring

The following provides some further detail on Woodside's oil spill scientific monitoring Program and includes the following:

- The organisation, roles and responsibilities of the Woodside oil spill scientific monitoring team and external resourcing.
- A summary table of the ten scientific monitoring programs as per the specific focus receptor, objectives, activation triggers and termination criteria.
- Details on the oil spill environmental monitoring activation and termination decision-making processes.
- Baseline knowledge and environmental studies knowledge access via geo-spatial metadata databases.
- An outline of the reporting requirements for oil spill scientific monitoring programs.

Oil Spill Scientific Monitoring – Delivery Team Roles and Responsibilities

Woodside Oil Spill Scientific Monitoring Delivery Team

The Woodside science team are responsible for the delivery of the oil spill scientific monitoring. The roles and responsibilities of the Woodside scientific monitoring delivery team are presented in Table C-1 and the organisational structure and 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 SMP service providers who hold a standby contract for SMP (SMP Standby Contractor) via the Woodside Environmental Services Panel (ESP). In the event that additional resources are required, other consultancy capacity within the Woodside ESP will be used (as needed and may extend to specialist contractors such as research agencies engaged in long-term marine monitoring programs). In consultation with the SMP Standby Contractor and/or specialist contractors, the selection, field sampling and approach of the SMPs will be determined by the nature and scale of the spill.

Table C-1: Woodside and Environmental Service Provider – Oil Spill Scientific Monitoring Program Delivery Team Key Roles and Responsibilities

Role	Location	Responsibility
Woodside Roles		
SMP Lead/Manager	Onshore (Perth)	• Approves activated the SMPs based on operational monitoring data provided by the Planning Function • Provides advice to the ICC in relation to scientific monitoring • Provides technical advice regarding the implementation of scientific monitoring • Approves detailed sampling plans prepared for SMPs • Directs liaison between statutory authorities, advisors and government agencies in relation to SMPs.
SMP Co-ordinator	Onshore (Perth)	• Activates the SMPs based on operational monitoring data provided by the Planning Function • Sits in the Planning function of the ICC. • Liaises with other ICC functions to deliver required logistics, resources and operational support from Woodside to support the Environmental Service Provider in delivering on the SMPs. Acts as the conduit for advice from the SMP Lead/Manager 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.

Role	Location	Responsibility
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 lead in-field by a party chief).

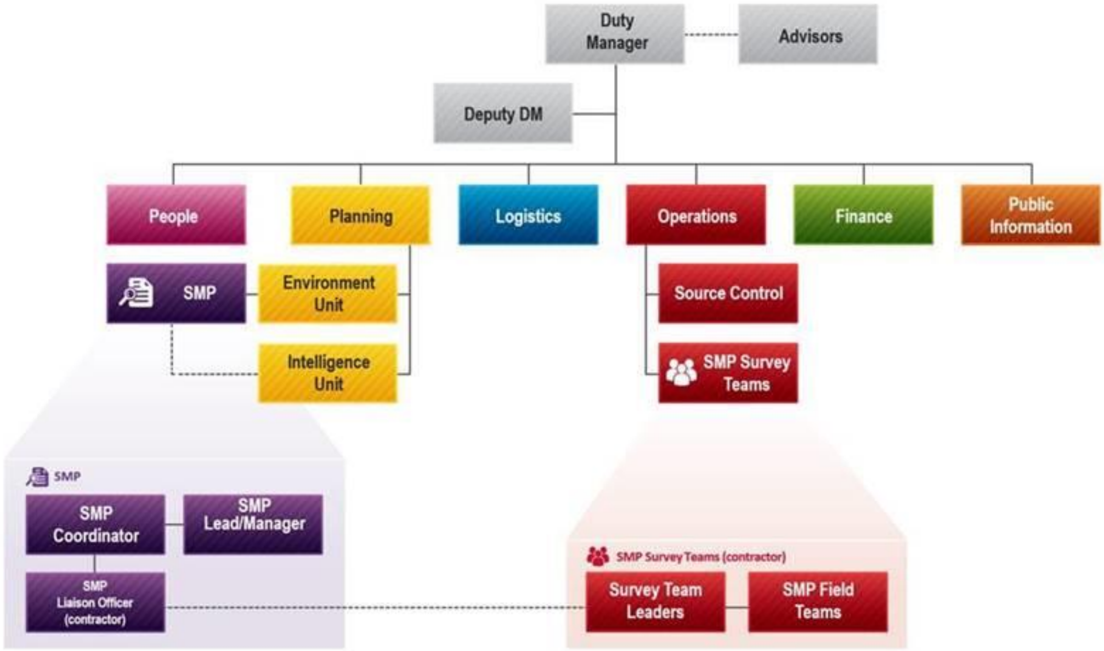

Figure C-1: Woodside Oil Spill Scientific Monitoring Program Delivery Team and Linkage to ICC organisational structure.

Table C-2: Oil Spill Environmental Monitoring: Scientific Monitoring Program - Objectives, Activation Triggers and Termination Criteria

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
Scientific monitoring program 1 (SM01) **Assessment of Hydrocarbons in Marine Waters**	SM01 will detect and monitor the presence, extent, persistence and properties of hydrocarbons in marine waters following the spill and the response. The specific objectives of SM01 are as follows: • Assess and document the extent, severity and persistence of hydrocarbon contamination with reference to observations made during surveillance activities and / or in-water measurements made during operational monitoring; and • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs.	SM01 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors.	SM01 will be terminated when: • Operational monitoring data relating to observations and / or measurements of hydrocarbons on and in water have been compiled, analysed and reported; and • The report provides details of the extent, severity and persistence of hydrocarbons which can be used for analysis of impacts recorded for sensitive receptors monitored under other SMPs. SMP monitoring of sensitive receptor sites: • Concentrations of hydrocarbons in water samples are below NOPSEMA guidance note (2019[9]) concentrations of 1 g/m^2 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, five ppb for entrained/dissolved hydrocarbons and ≥one 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[10]) 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, five ppb for entrained/dissolved hydrocarbons and ≥one 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 • Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options).	SM04 will be activated in the event of a Level two or three 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; and	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. • Recovery of impacted mangrove/saltmarsh habitat has been evaluated.

[9] NOPSEMA (2019) Bulletin #1 – Oil spill modelling – April 2019, https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf
[10] Simpson SL, Batley GB and Chariton AA (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO and Water Science Report 08/07. Land and Water, pp. 132.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	SM03 will be supported by sediment sampling undertaken in SM02 and characteristics of the spill derived from OMPs.	• Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, five ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for mangrove/saltmarsh habitat.	• 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, five 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; • Dugongs; • Whale sharks and other shark and ray populations; • Sea snakes; and • Crocodiles.	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 records of dead, oiled or injured non-avian marine megafauna during the spill/ response phase.	SM08 will be terminated when the results of the post-spill monitoring have quantified impacts to non-avian megafauna. • 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 (SMP)	Objectives	Activation Triggers	Termination Criteria
	The desk-based assessment will include population analysis to infer potential impacts to marine megafauna species populations.		
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), gonadosomatic 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 ≥five ppb for entrained/dissolved hydrocarbons); and • Taste, odour or appearance of seafood presenting a potential human health risk is observed.	SM10 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Physiological impacts to important commercial fish and shellfish species from hydrocarbon exposure have been quantified. • Recovery of important commercial fish and shellfish species from hydrocarbon exposure has been evaluated. • Impacts to seafood quality/safety (if applicable) have been assessed and information provided to the relevant stakeholders and regulators for the management of any impacted fisheries. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.

Activation Triggers and Termination Criteria

Scientific Monitoring Program Activation

The Woodside oil spill scientific monitoring team will be stood up immediately with the occurrence of a hydrocarbon spill (actual or suspected) Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors via the FSRP for the PAP. 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 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 what SMPs are activated and 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 WHA, AMPs, State Marine Parks, other protected area designations (e.g., State nature reserves) and Matters of National Environmental Significance (including listed species under part 3 of the EPBC Act).

The SMP termination decision-making process will be applied to each active SMP and an iterative process of decision steps continued until each SMP has been terminated (refer to decision-tree diagram for SMP termination criteria, Figure C-3).

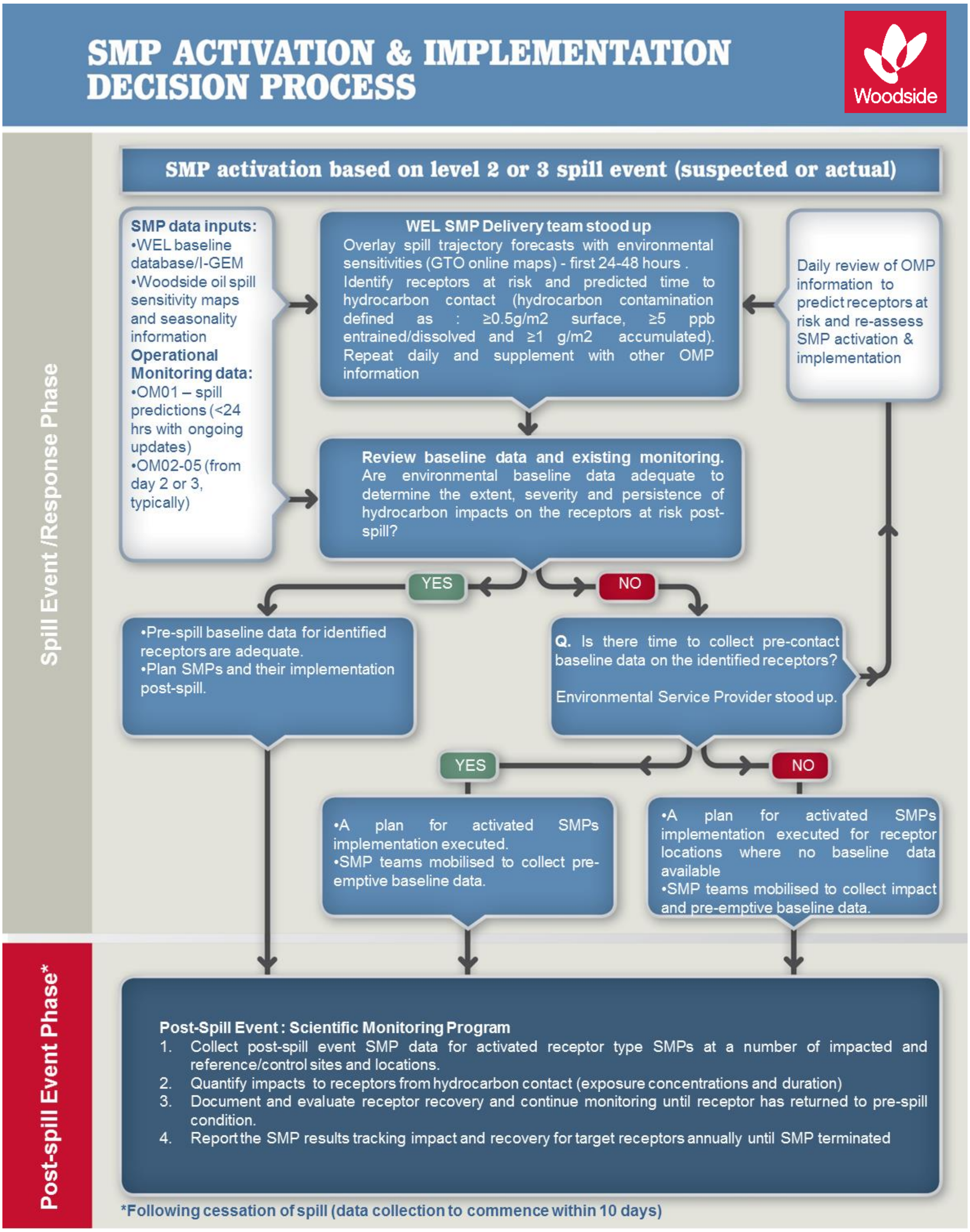

Figure C-2: Activation and Implementation Decision-tree for Oil Spill Environmental Monitoring

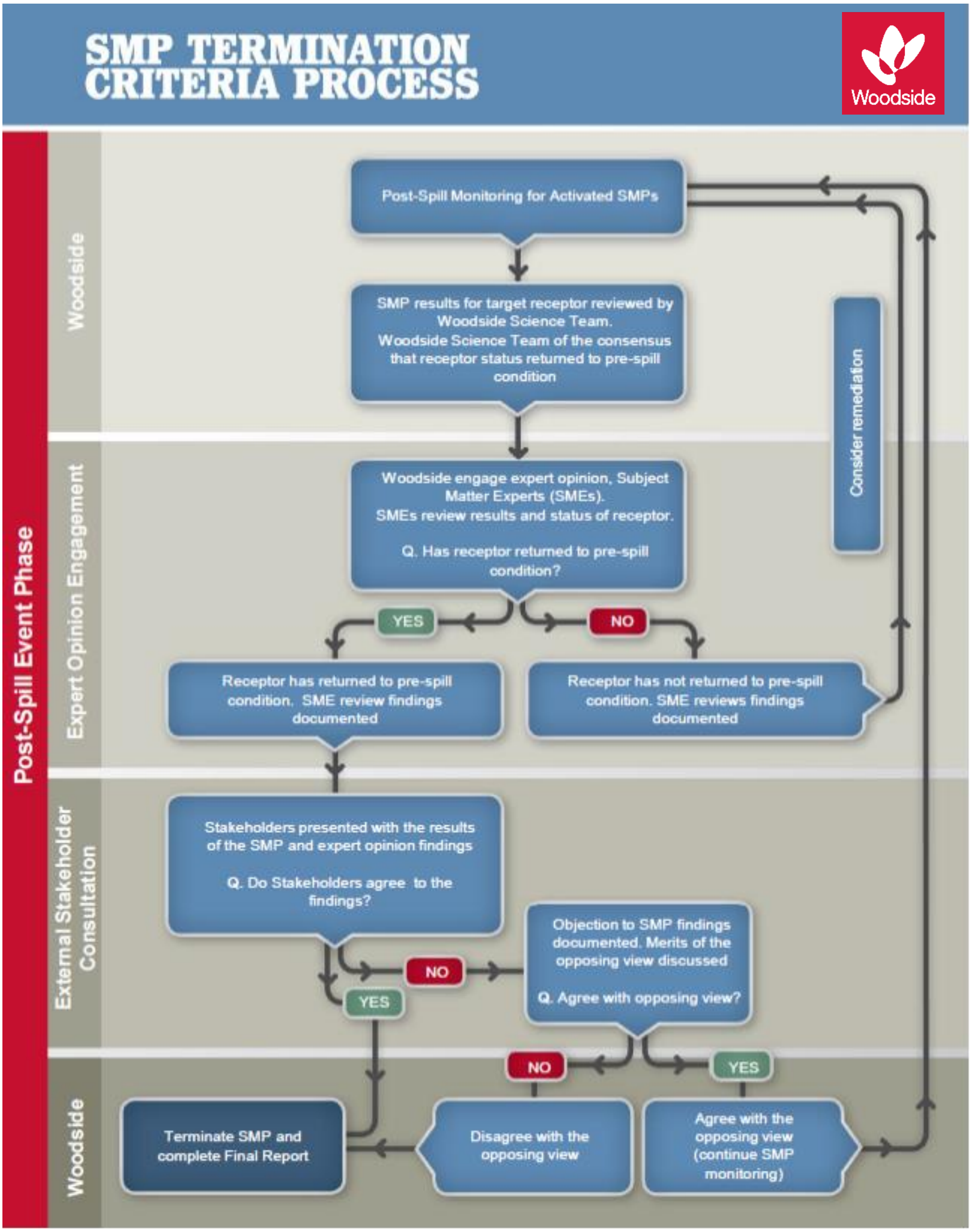

Figure C-3: Termination Criteria Decision-tree for Oil Spill Environmental Monitoring

Receptors at Risk and Baseline Knowledge

In order to assess the baseline studies available and suitability for oil spill scientific monitoring, Woodside maintains knowledge of environmental baseline studies through the upkeep and use of its Environmental Knowledge Management System.

Woodside's Environmental Knowledge Management System is a centralised platform for scientific information on the existing environment, marine biodiversity, Woodside environmental studies, key environmental impact topics, key literature and web-based resources. The system comprises a number of data directories and an environmental baseline database, as well as folders within the 'Corporate Environment' server space. The environmental baseline database was set up to support Woodside's SMP preparedness and as a SMP resource in the event of an unplanned hydrocarbon spill. The environmental baseline database is subject to updates including annual reviews completed as part of the contracted SMP standby, SMP standby contract. This database is accessed pre-PAP to identify 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 Meta-database, IGEM) was established. IGEM is a collaboration comprising oil and gas operators (including Woodside), government and research agencies and other organisations. The key objective of IGEM is for participating organisations to have the ability to identify quantitative marine baseline datasets available for species and habitats via a geo-spatially referenced metadata database. It provides members the ability to enter, view and filter metadata records on baseline studies as well as customise and generate report outputs. IGEM aims to provide a foundational baseline framework so industry and government can access the same knowledge base to understand baseline data in the event of an unplanned hydrocarbon release.

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, IGEM and other sources of existing baseline data) to identify 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.

ANNEX D: SCIENTIFIC MONITORING PROGRAM AND BASELINE STUDIES FOR THE PETROLEUM ACTIVITIES PROGRAM

Table D-1: Oil Spill Environmental Monitoring – scientific monitoring program scope for the Petroleum Activities Program based on worst-case credible Spill MEE 1 and 5

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 Shoals	Rowley Shoals (including Sate Maine Park)	Fantome Shoal	Adele Island	Lacepede Islands	Montebello Islands (including State Marine Park)	Lowendal Islands (including State Nature Reserves)	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	Muiron Islands (WHA, Marine Management Area)	Pilbara Islands - Southern Island Group (Serrurier, Thevenard and Bessieres Islands - State Nature Reserves)	Pilbara Islands - Northern Island Group (Sandy Island Passage Islands - State nature reserves)	Abrolhos Islands	Kimberley Coast	Dampier Peninsula	Northern Pilbara Shoreline	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	Shark Bay - Open Ocean Coast	Shark Bay (WHA, State Marine Park)	Ngari Capes State Marine Park
Habitat																																									
Water Quality	SM01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marine Sediment Quality	SM02	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Coral Reef	SM03	X		X												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	
Seagrass / Macro-Algae	SM03	X									X					X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Deeper Water Filter Feeders	SM03	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X							X			
Mangroves and Saltmarsh	SM04																											X						X	X	X	X	X		X	
Species																																									
Sea Birds and Migratory Shorebirds (significant colonies / staging sites / coastal wetlands)	SM05	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marine Turtles (significant nesting beaches)	SM06	X	X	X	X		X	X	X							X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pinnipeds (significant colonies / haul-out sites)	SM07									X	X	X			X																										X
Cetaceans - Migratory Whales	SM08	X	X	X	X		X	X	X	X	X	X	X	X	X			X									X	X	X	X	X			X	X	X		X		X	X
Oceanic and Coastal Cetaceans	SM08	X	X	X	X		X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dugongs	SM08	X							X							X												X	X	X	X	X	X		X	X	X	X	X	X	
Sea Snakes	SM08	X		X	X			X	X	X						X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Whale Sharks	SM08			X			X	X										X										X	X	X	X							X			
Other Shark and Ray Populations	SM08, SM09	X	X	X	X		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fish Assemblages	SM09	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Socio-economic																																									
Fisheries - Commercial	SM10		X	X	X	X	X	X	X	X	X	X										X	X	X	X			X	X	X		X	X	X	X	X	X	X	X	X	X
Fisheries - Traditional	SM10															X	X	X									X													X	
Tourism (incl. recreational fishing)	SM10	X		X			X	X	X		X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X

(dark red)	Receptor areas identified as Pre-emptive Baseline Areas (based on criteria of surface contact and/or entrained hydrocarbon contact ≤10 days (Offshore Australian Marine Parks contacted by hydrocarbons in this timeframe also noted)
(light red)	Receptor areas identified as Pre-Emptive Basline Areas in the response phase >10 days (based on criteria of surface contact and/or entrained hydrocarbon contact >10 days)
(white)	Receptor areas that may be identified as impact or reference sites in the event of major hydrocarbon release and would be identified as part of the SMP planning process

Table D-2: Baseline Studies for the SMPs applicable to identified Pre-emptive Baseline Areas for the PAP

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Ningaloo and Muiron Islands
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. AIMS/DBCA 2014 Baseline Ningaloo and Muiron Islands Survey – repeat and expansion on the LTM (Co-funded survey: Woodside and AIMS). Preparation underway to undertake LTM program in 2020. 2. Australian Institute of Marine Science – CReefs: Ningaloo Reef Biodiversity Expeditions (2008-2010). 3. DBCA LTM Ningaloo Reef programme: 1991, 1994, 1998, 1999, 2001, 2005, 2006, 2010, 2011, 2012, 2015 and 2016 4. (WAMSI LTM Study:) Ningaloo Research node: 2009 -10 over the length of Ningaloo reef system (with a focus on coral and fish recruitment). 5. Ningaloo Outlook (CSIRO) - Shallow and Deep Reefs Program (2019). 6. Ningaloo Collaboration Cluster: Habitats of the Ningaloo Reef and adjacent coastal areas determined through hyperspectral imagery. 7. AIMS Long Term Monitoring (LTM) Ningaloo Reef programme: 1995 and 2002. 8. Le Nohaic et al. 2017.Marine heatwave causes unprecedented Regional Mass Bleaching in NW Australia Coral Bay Location). **Methods:** 1. LTM sites, transects, diver-based video quadrat. 2. LTM transects, diver based (video) photo quadrats, specimen collection 3. Video point intercept transects recorded by towed video or diver hand-held video camera. 4. Video transects. 5. LTM transects, diver based (video) photo quadrat. 6. LTM transects, diver based (video) photo quadrat. 7. LTM transects, diver based (video) photo quadrat. 8. Intertidal walks and snorkelling transects with photo quadrats. In situ water temperature loggers deployed for survey period. **References and Data:**

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Ningaloo and Muiron Islands
		1. AIMS 2015. DATAHOLDER: AIMS. 2. AIMS (2010) - http://www.aims.gov.au/creefs 3. DBCA unpublished data. DATAHOLDER: DBCA 4. Depczynski et al. 2011. DATAHOLDER: AIMS, DBCA and WAMSI. 5. CSIRO 2019 – Ningaloo Outlook Program 6. Murdoch University - Kobryn et al 2011 and Keulen and Langdon 2011. 7. AIMS unpublished data. DATAHOLDER: AIMS. 8. Le Nohaic et al., 2017
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. Quantitative descriptions of Ningaloo sanctuary zones habitats types including lagoon and offshore areas – Cassata and Collins (2008). 2. CSIRO/BHP Ningaloo Outlook Program. 3. Ningaloo Collaboration Cluster: Habitats of the Ningaloo Reef and adjacent coastal areas determined through hyperspectral imagery. 4. Australian Institute of Marine Science – CReefs: Ningaloo Reef Biodiversity Expeditions (2008-2010).
		Methods:
		1. Video transects to ground truth aerial photographs and satellite imagery. 2. Diver video transects. 3. LTM transects, diver based (video) photo quadrat. 4. LTM transects, diver based (video) photo quadrats, specimen collection.
		References and Data:
		1. Cassata and Collins 2008. DATAHOLDER: Curtin University – Applied Geology. 2. CSIRO – Ningaloo Outlook Program 3. Murdoch University - Kobryn et al 2011 and Keulen and Langdon 2011. 4. AIMS (2010) - http://www.aims.gov.au/creefs
	SM03	**Studies:**

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Ningaloo and Muiron Islands
Benthic Habitat (Deeper Water Filter Feeders)	Quantitative assessment using image capture using towed video. Post analysis into broad groups based on taxonomy and morphology.	1. WAMSI 2007 deep-water Ningaloo benthic communities' study, Colquhoun and Heyward (2008). 2. CSIRO/BHP Ningaloo Outlook Program - Deep reef themes. 2019
		Methods:
		1. Towed video and benthic sled (specimen sampling). 2. Side-scan sonar and AUV transects.
		References and Data:
		1. Colquhoun and Heyward (eds) 2008. DATAHOLDER: WAMSI, AIMS. 2. CSIRO – Ningaloo Outlook
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:**
		1. Atmospheric correct and land cover classification, NW Cape. 2. Woodside hold Rapid Eye imagery of the Ningaloo Reef and coastal area. 3. Hyperspectral survey (2006) of Ningaloo Reef and coastal area (not yet analysed for Mangroves). 4. North West Cape sensitivity mapping 2012 included Mangrove Bay. 5. Global mangrove distribution as mapped by the USGS and located on UNEP's Ocean Data viewer.
		Methods:
		1. Modular Inversion Program. May 2017 2. Rapid Eye imagery – High resolution satellite imagery from October/November/December 2011. 3. Remote sensing – acquisition of HyMap airborne hyperspectral imagery and ground truthing data collection. 4. Reconnaissance surveys of the shorelines of the North West Cape and Muiron Islands. 5. Remote sensing study of global mangrove coverage.
		References and Data:
		1. EOMAP, 2017 DATAHOLDER: Woodside. 2. AAM 2014. Dataholder: Woodside 3. Kobryn et al. 2013. DATAHOLDER: Murdoch University, AIMS; Woodside. 4. Joint Carnarvon Basin Operators, 2012. DATAHOLDER: Woodside Apache Energy Ltd. 5. http://data.unep-wcmc.org/
Seabirds	**SM05**	**Studies:**

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Ningaloo and Muiron Islands
	Visual counts of breeding seabirds, nest counts, intertidal bird counts at high tide.	1. LTM Study of marine and shoreline birds: 1970-2011. 2. LTM of shorebirds within the Ningaloo coastline (Shorebirds 2020). 3. Exmouth Sub-basin Marine Avifauna Monitoring Program (Quadrant Energy/Santos). 4. Seabird and Shorebird baseline studies, Ningaloo Region – Report on January 2018 bird surveys. 5.Wedge-tailed shearwater foraging behaviour in the Exmouth Region – Final Report
		Methods:
		1. Counts of nesting areas, counts of intertidal zone during high tide. 2. The Shorebirds 2020 database comprises the most complete shorebird count data available in Australia. The data have been collected by volunteer counters and BirdLife Australia staff for approximately 150 roosting and feeding sites, mainly in coastal Australia. The data go back as far as 1981 for key areas. 3. The Exmouth Sub-basin Marine Avifauna Monitoring Program undertook a detailed assessment of seabird and shorebird use in the Exmouth Sub-basin. Four aerial surveys and four island surveys were conducted between February 2013 and January 2015 for this Program, inclusive of the mainland coasts, offshore islands and a 2,500 km^2 area of ocean adjacent to the Exmouth Sub-basin. 4.Shorebird counts, Shearwater Burrow Density. 5. Tagging (GPS & Satellite).
		References and Data:
		1. Johnstone et al. 2013. DATAHOLDER: WA MUSEUM. AMOSC/DBCA (DPaW) 2014. 2. BirdLife Australia Dataholder: Woodside 3. Surman & Nicholson 2015. 4. BirdLife Australia: Dataholder. Woodside 5. Cannel et al. 2019 Dataholder. UWA
Turtles	**SM06** Beach surveys (recording species, nests, and false crawls).	**Studies:**
		1. Exmouth Islands Turtle Monitoring Program. 2. Ningaloo Turtle Program Annual Report 2017-2018. 3. Turtle activity and nesting on the Muiron Islands and Ningaloo Coast: Final Report (2019). 4. Spatial and temporal use of inter-nesting habitat by sea turtles along the Murion Islands and Ningaloo Coast – Final Report (2019).
		Methods:

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Ningaloo and Muiron Islands
		1. Astron (on behalf of Santos) to address a gap in the knowledge of turtle numbers at key locations (offshore islands within the region) that are not currently part of an existing monitoring programs (e.g. the NTP). Field surveys were conducted in October 2013 and January 2014. Surveys were conducted on 12 islands, with each island surveyed once (with the exception of Beach 8 at North Muiron Island) and all tracks counted. 2. Long term trends in marine turtle populations, beach surveys, track counts, best location, mortality counts. 3. On-beach monitoring and aerial surveys. 4. Tagging (satellite transmitter), analysis of internesting, migration and foraging grounds movements and behaviour.
		References/Data:
		1.Santos – Report. 2. Coote 2018 DATAHOLDERS: DBCA. Reports available at http://www.ningalooturtles.org.au/media_reports.html 3.Rob et al. 2019 DBCA Dataholder. 4.Tucker et al. 2019 DBCA Dataholder.
Fish	**SM09** Baited Remote Underwater Video Stations (BRUVS), Visual Underwater Counts (VUC), Diver Operated Video (DOV).	**Studies:**
		1. AIMS/DBCA 2014 Baseline Ningaloo Survey – repeat and expansion on the LTM (Co-funded survey: Woodside and AIMS). 2. Demersal fish populations – baseline assessment (AIMS/WAMSI). 3. DBCA study measured Species Richness, Community Composition, and Target Biomass, through UVC. BRUVS studies determining max N, Species Richness, and Biomass. 4. Pilbara Marine Conservation Partnership Stereo BRUVS in shallow water (~10m) in 2014 in northern region of the Ningaloo Marine Park, in shallow water (~10m) inside the lagoonal reef of the Ningaloo Marine Park in 2016, in deep water (~40m) across the length of the Ningaloo Marine Park in 2015, in shallow water outside of Ningaloo Reef from Waroora to Jurabi in 2015 and offshore of the Muiron Islands in 2015. 5. Elasmobranch faunal composition of Ningaloo Marine Park. 6. Juvenile fish recruitment surveys at Ningaloo reef. 7. Demersal fish assemblage sampling method comparison 8. Ningaloo Outlook (CSIRO) - Shallow and Deep Reefs Program
		Methods:

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Ningaloo and Muiron Islands
		1. UVC surveys. 2. BRUVS Study with 304 video samples at three specific depth ranges (1-10 m, 10-30 m and 30-110m). 3. UVC surveys. 4. Stereo BRUVS 5. Snorkel and Scuba surveys. 5. Underwater visual census. 6. Diver operated video. 7. Diver UVS.
		References/Data:
		1. AIMS 2014. DATAHOLDER: AIMS/Woodside. 2. Fitzpatrick et al. 2012. DATAHOLDERS: WAMSI, AIMS. 3. DBCA unpublished data. DATAHOLDER: DBCA/AIMS. 4. CSIRO Data DATAHOLDER: CSIRO Data Centre (data-requestes-hf@csiro.au). 5. Stevens, J.D: ast, P.R., White, W.T., McAuley, R.B., Meekan, M.G. 2009. 6. WAMSI unpublished data DATAHOLDER: AIMS (m.case@aims.gov.au). 7. WAMSI DATAHOLDER: Ben Fitzpatrick (whaleshark@oceanwise.com.au). 8. CSIRO – Ningaloo Outlook 2019.

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ANNEX E: TACTICAL RESPONSE PLANS

TACTICAL RESPONSE PLANS
Exmouth
Mangrove Bay
Turquoise Bay
Yardie Creek
Muiron Islands
Jurabi to Lighthouse Beaches Exmouth
Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek
Exmouth Gulf
Shark Bay Area 1: Carnarvon to Wooramel
Shark Bay Area 2: Wooramel to Petite Point
Shark Bay Area 3: Petite Point to Dubaut Point
Shark Bay Area 4: Dubaut Point to Herald Bight
Shark Bay Area 5: Herald Bight to Eagle Bluff
Shark Bay Area 6: Eagle Bluff to Useless Loop
Shark Bay Area 7: Useless Loop to Cape Bellefin
Shark Bay Area 8: Cape Bellefin to Steep Point
Shark Bay Area 9: Western Shores of Edel Land
Shark Bay Area 10: Dirk Hartog Island
Shark Bay Area 11: Bernier and Dorre Islands
Abrohlos Islands: Pelseart Group
Abrohlos Islands: Wallabi Group
Abrohlos Islands: Easter Group
Dampier
Rankin Bank & Glomar Shoals
Barrow and Lowendal Islands
Pilbara Islands - Southern Island Group
Montebello Island - Stephenson Channel Nth TRP
Montebello Island Champagne Bay and Chippendale channel TRP
Montebello Island - Claret Bay TRP
Montebello Island - Hermite/Delta Island Channel TRP
Montebello Island - Hock Bay TRP
Montebello Island - North and Kelvin Channel TRP
Montebello Island - Sherry Lagoon Entrance TRP
Withnell Bay
Holden Bay
King Bay
No Name Bay / No Name Beach
Enderby Is -Dampier
Rosemary Island - Dampier
Legendre Is - Dampier

Karratha Gas Plant
KGP to Whitnell Creek
KGP to Northern Shore
KGP Fire Pond & Estuary
KGP to No Name Creek
Broome
Sahul Shelf Submerged Banks and Shoals
Clerke Reef (Rowley Shoals)
Imperieuse Island (Rowley Shoals)
Mermaid Reef (Rowley Shoals)
Scott Reef
Oiled Wildlife Response
Exmouth
Dampier region
Shark Bay

APPENDIX E: NOPSEMA REPORTING FORMS

NOPSEMA Recordable Environmental Incident Monthly Reporting Form: https://www.nopsema.gov.au/assets/Forms/A198750.doc

Report of an accident, dangerous occurrence or environmental incident: https://www.nopsema.gov.au/assets/Forms

APPENDIX F: STAKEHOLDER CONSULTATION

Nganhurra Cessation of Operations Environment Plan Revision

Date September 2020
Revision: 0

TABLE OF CONTENTS

1. CONSULTATION

1.1 Email sent to relevant stakeholders

Woodside sent the email below and consultation Information Sheet below to:

- *Australian Customs Service*
- *DIIS*
- *DMIRS*
- *APPEA*

Dear stakeholder

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels
Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring • A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities • The following new Operational Areas will also apply for the duration of activities:

	• 500 m radius around the riser turret mooring • 4000 m radius around all wells • 500 m around all flowlines

Your feedback
Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.2 Woodside Consultation Information Sheet

Woodside

STAKEHOLDER CONSULTATION
INFORMATION SHEET

October 2019

NGANHURRA OPERATIONS CESSATION ENVIRONMENT PLAN REVISION

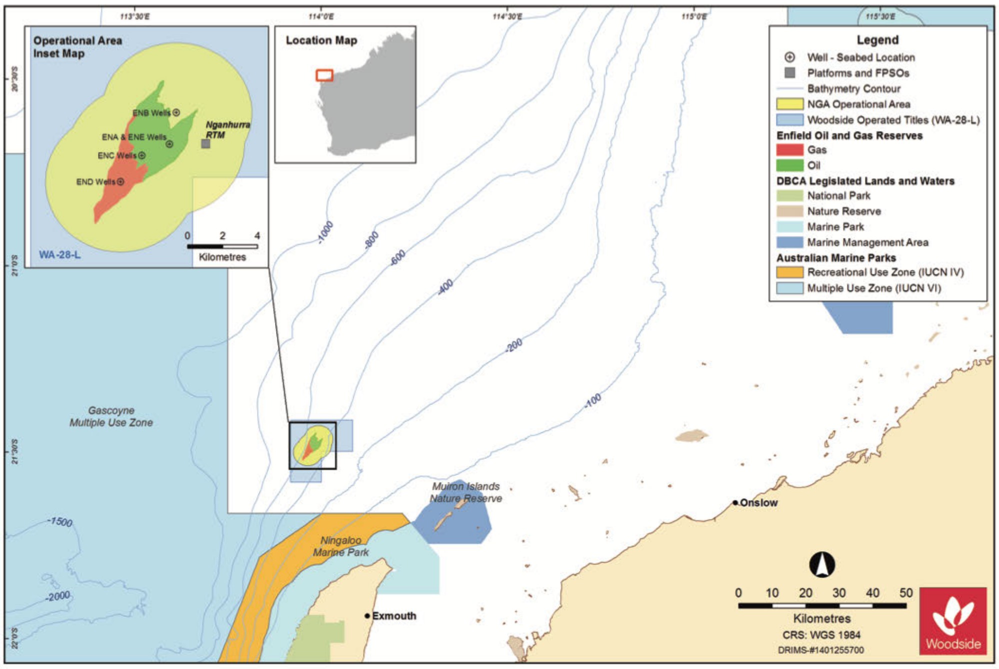
EXMOUTH PLATEAU SUB-BASIN

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production in 2018.

A number of activities have already been undertaken at WA-28-L under the existing Nganhurra Operations Cessation Environment Plan accepted by NOPSEMA in December 2017. Some activities were not able to be completed throughout the duration of the Environment Plan. As a result, Woodside is submitting a revised Environment Plan to NOPSEMA.

Activities planned under the revised cessation of operations Environment Plan include disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring, removal of the riser turret mooring from the field and activities for the long-term management of the existing development wells.

Production licence WA-28-L is held by Woodside (Operator and 60%) and Mitsui E&P Australia Pty Ltd (40%).



1 Nganhurra Operations Cessation Environment Plan Revision | October 2019

Table 1. Activity summary

Nganhurra FPSO cessation of operations	
Commencement dates	+ Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring + From 2021 for well activities depending on rig availability
Approximate estimated duration	+ 30 days for the removal of the riser turret mooring + 10-20 days per well for well intervention
Project vessels for removal of the riser turret mooring	+ Primary intervention vessel + Anchor Handling Tugs
Project vessels for well management	+ Light well intervention vessel (LWIV) + Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) + Support vessels, including anchor handling vessels, heavy lift vessels and activity support vessels + Inspection, Maintenance and Repair (IMR) vessel
Distance to nearest town	+ 38 km north-west of Exmouth
Distance to nearest marine park	+ -15 km north west of the Commonwealth boundary of the Ningaloo Marine Park + -15 km north of the Gascoyne Commonwealth Marine Reserve + -30 km north west of the Muiron Islands Marine Management and Conservation Area

Proposed activity

The Enfield oil field was discovered by Woodside in 1999 and commenced production in 2006 by way of subsea wells tied back to the Nganhurra FPSO.

At the end of the economic production life of the facility, the Nganhurra operations comprised 18 wells, eight of which were used for oil production, eight for water re-injection and two for gas re-injection or production. These wells were tied back to the Nganhurra FPSO via four sub-sea manifolds and associated flowlines via a riser turret mooring.

In December 2017 NOPSEMA accepted an Environment Plan for the cessation of operations in preparation for future decommissioning. The majority of activities planned under this Environment Plan have been completed, including disconnection of the FPSO and sail away in December 2018 from the Operational Area, isolation of the production wells, preservation of the subsea production infrastructure, and laying of an umbilical and risers on the seabed.

The removal of the riser turret mooring was not able to be completed. As a result, a revised Environment Plan will be submitted to NOPSEMA to complete this activity, as well as activities for well intervention in preparation for permanently plugging the 18 wells.

Riser turret mooring removal

The riser turret mooring is about 83 m in length and between 4.5 m and 8.5 m in diameter and sits approximately 6.5 m above the sea surface and anchored to the seabed by three sets of three mooring lines. The riser turret mooring weighs almost 2,500 tonnes, which includes solid and sea water ballast.

In 2018 the risers were flushed and cut from the riser turret mooring and laid on the seabed. Under the revised cessation of operations Environment Plan, Woodside plans to disconnect the anchor chains and lay them on the seabed for future decommissioning. The riser turret mooring will then be towed to a disposal location outside the Operational Area.

Once the riser turret mooring is outside of the Operational Area, it will be subject to all applicable maritime regulations and other requirements. Activities relating to disposal of the riser turret mooring are not included in the revised cessation of operations Environment Plan and will be managed through other approval processes.

Long-term well management

All of the Enfield wells have been shut-in and are currently in a state of preservation. Long-term management measures for these wells may be undertaken in one or multiple stages.

Initial temporary plug installation may be undertaken using a light well intervention vessel or a mobile offshore drilling unit. Subsequent operations, including installation of permanent abandonment plugs, will require the use of a mobile offshore drilling unit. These activities will be subject to a separate Environment Plan.

Woodside has been monitoring the wells and will continue to do so until permanent management measures are implemented.

Activities for the riser turret mooring removal and management of the wells will be 24 hours per day, seven days per week and timing and duration of these activities is subject to change due to project schedule requirements, drill rig and vessel availability, weather or unforeseen circumstances.

Decommissioning of remaining equipment, including flowlines, spools, manifolds and the umbilical, will be subject to future stakeholder engagement and Environment Plan.

Communications with mariners

The riser turret mooring has an existing 500 m petroleum safety zone. Non-authorised vessels are prohibited from entering this area for safety reasons. The petroleum safety zone will be removed once the riser turret mooring has been removed from the Operational Area.

Petroleum safety zones of 500 m will be in place around the intervention vessels and mobile offshore drilling unit whilst in the field for the duration of activities. The following new Operational Areas will also apply under the revised Environment Plan:

+ 1500 m radius around the riser turret mooring
+ 4000 m radius around all wells
+ 500 m around all flowlines

Marine notices will be issued prior to activity commencement to alert vessels which maybe operating in waters nearby.

Proposed locations

The Operational Area is located in WA-28-L in Commonwealth waters approximately 38 km north of Exmouth. The riser turret mooring and well locations are provided in Table 2.

Table 2. Approximate locations

Structure	Water depth (m)	Latitude	Longitude
Riser turret mooring	400	21° 28′ 53.268″ S	114° 00′ 29.249″ E
Production Wells			
ENA01	513	21° 28′ 54.064″ S	113° 59′ 21.678″ E
ENA02	513	21° 28′ 53.564″ S	113° 59′ 21.236″ E
ENA03	515	21° 28′ 54.289″ S	113° 59′ 20.402″ E
ENA04	513	21° 28′ 55.221″ S	113° 59′ 21.573″ E
ENA05	513	21° 28′ 54.803″ S	113° 59′ 21.012″ E
ENE01	550	21° 28′ 53.335″ S	113° 59′ 17.083″ E
ENE02	520	21° 28′ 53.958″ S	113° 59′ 17.693″ E
ENE03	520	21° 28′ 52.842″ S	113° 59′ 17.851″ E
Water Injection Wells			
ENB01	495	21° 27′ 55.752″ S	113° 59′ 34.297″ E
ENB02	495	21° 27′ 55.337″ S	113° 59′ 34.719″ E
ENB03	495	21° 27′ 56.005″ S	113° 59′ 35.450″ E
ENC01	550	21° 29′ 14.814″ S	113° 58′ 30.698″ E
ENC02	550	21° 29′ 15.281″ S	113° 58′ 30.267″ E
ENC03	550	21° 29′ 15.457″ S	113° 58′ 31.396″ E
ENC04	550	21° 29′ 14.920″ S	113° 58′ 30.020″ E
ENC05	550	21° 29′ 15.920″ S	113° 58′ 31.392″ E
Gas Injection Wells			
END01	550	21° 30′ 3.582″ S	113° 57′ 51.152″ E
END02	550	21° 30′ 3.853″ S	113° 57′ 50.826″ E

Implications for Stakeholders

Woodside will consult relevant stakeholders whose interests, functions, and 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 the planned activities.

A number of mitigation and management measures will be implemented and are summarised in Table 3. Further details will be provided in the revised Environment Plan.

Table 3. Summary of key risks and/or impacts and management measures.

Potential Risk and/or Impact	Mitigation and/or Management Measure
Planned	
Chemical use	+ Chemical use will be managed in accordance with Woodside and contractor chemical selection and approval procedures.
Interests of relevant stakeholders including: + **Commercial and recreational fishing activities** + **Petroleum activities** + **Shipping activities**	+ Consultation with relevant petroleum titleholders, commercial and recreational fishers and their representative organisations, and government departments and agencies to inform decision making for the proposed activity and development of the Environment Plan. + Advice to relevant stakeholders prior to the commencement of activities.
Marine fauna interactions	+ Measures will be taken to protect marine fauna and ecosystems from vessel activities and to prevent vessel collisions and groundings. + Implementation of the Woodside Exmouth Gulf Vessel Management Plan.
Marine discharges	+ All routine marine discharges will be managed according to legislative and regulatory requirements and Woodside's Environmental Performance Standards where applicable.
Seabed disturbance	+ Mobile offshore drilling unit mooring analysis, anchor deployment, if required, in accordance with internal standards. + Anchoring of intervention vessels during intervention if required, as well as logging/retrieval of wet-stored items. + No anchoring of support vessels.

Vessel interaction	+ Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on-location dates and any exclusion zones prior to commencement of the activity.
	+ A 500m radius petroleum safety zone will remain in place around the riser turret mooring until it is removed from the Operational Area.
	+ A 500 m radius petroleum safety zone will be in place around the light well intervention vessel and the mobile offshore drilling unit for the duration of activities.
	+ The following new Operational Areas will also apply:
	  + 1500 m radius around the riser turret mooring
	  + 4000 m radius around all wells
	  + 500 m around all flowlines
	+ Commercial fishers and other marine users are able to use but should take care when entering the Operational Area.

Waste generation	+ Waste generated on the vessels will be managed in accordance with legislative requirements and a Waste Management Plan. + Waste will be managed and disposed of in a safe and environmentally responsible manner that prevents accidental loss to the environment. + Waste transported onshore will be sent to appropriate recycling or disposal facilities by a licensed waste contractor.
Unplanned	
Hydrocarbon release	+ Appropriate spill response plans, equipment and materials will be in place and maintained. + Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment.
Introduction of invasive marine species	+ All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. + Compliance with Australian biosecurity requirements and guidance.

Providing feedback

Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

If you would like to comment on the proposed activities outlined in this information sheet, or would like additional information, please contact Woodside before **8 November 2019.**

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.

Andrew Winter, *Senior 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

1.3 Email sent to DPIRD, WAFIC and PPA (10 October 2019) and Pilbara Line Fishery licence holders (25 October 2019)

Dear [redacted]

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlap the proposed Operational Area in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance so these can be addressed.

A Consultation Information Sheet (also available on our website) and a map of State Fisheries relevant to the proposed activities is attached.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of government fishing effort data from recent years, fishing methods and water depth. Individual licence holders or representative fishing organisations who have requested ongoing advice on Woodside's planned activities will also be advised.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels
Relevant fisheries consulted for this activity*:	• State Fisheries o Pilbara Line Fishery

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	  ○ 1500 m radius around the riser turret mooring
	  ○ 4000 m radius around all wells
	  ○ 500 m around all flowlines

* Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of fishing effort data, fishing methods and water depth. Individual licence holders or representative fishing organisations who have requested ongoing advice on Woodside's planned activities will also be advised.

Potential risks to commercial fishing and proposed mitigation measures

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	• The presence of the primary project vessels and MODU, riser turret mooring, and subsea infrastructure may result in exclusion of other users, or interactions between vessels and the facility.	• Woodside will implement a 500 m radius petroleum safety zone around the primary project vessels and MODU whilst in the field for the duration of activities to reduce the likelihood of interactions. • An existing 500 m radius petroleum safety zone around the riser turret mooring will continue to exist while the riser turret mooring is in the field. This will be removed when the riser turret mooring is removed. • Notification and updates to mariners and marine charts. • Woodside will routinely consult with marine users to ensure they are informed and aware thereby reducing the likelihood of interactions.

Seabed disturbance	• Disturbance to the seabed from mooring of the MODU.
	• Disturbance to the seabed from removal of the riser turret mooring due to mooring chains being cut and laid on the sea bed.
		• Woodside will seek to minimise seabed disturbance for planned activities through:
		  ○ MODU mooring analysis and anchor deployment in accordance with internal standards.
		  ○ Laying the mooring chains in a pre-defined area defined to minimise disturbance.

Underwater noise	• Noise will be generated by the project vessels and MODU, and helicopters.	• Due to the low acoustic source levels associated with the MODU, well intervention activities and vessel operations there is not likely

		to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges	• Operational discharges from the project vessels and the MODU, including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	• Discharges are compliant with industry best practice standards. • Implementation of chemical assessment and approval process.
Unplanned Risks		
Hydrocarbon release	• Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting in a tank rupture.	• Procedures for the supply and transfer of fuel. • Design of the wells and barriers within the wells to prevent loss of hydrocarbons. • Well blow-out-preventers, which are large valves or similar mechanical devices used to seal, control and monitor oil and gas wells. • Relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. • Oil spill response strategies will be implemented based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. • Compliance with Australian biosecurity requirements and guidance.

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

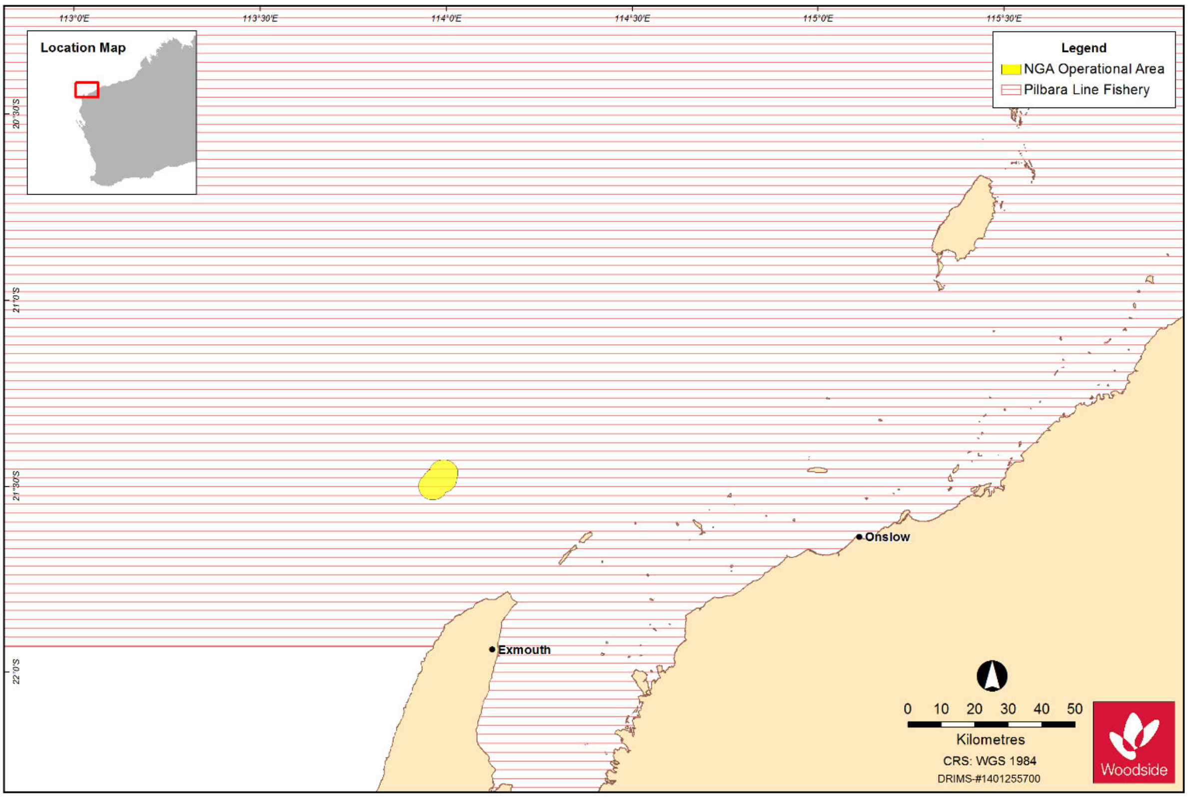
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.4 State Fisheries map sent to DPIRD, WAFIC and PPA (10 October 2019) and Pilbara Line Fishery licence holders (25 October 2019)



1.5 Email sent to DoD – 10 October 2019

Dear [redacted]

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of Defence areas relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	  ◦ 500 m radius around the riser turret mooring
	  ◦ 4000 m radius around all wells
	  ◦ 500 m around all flowlines

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

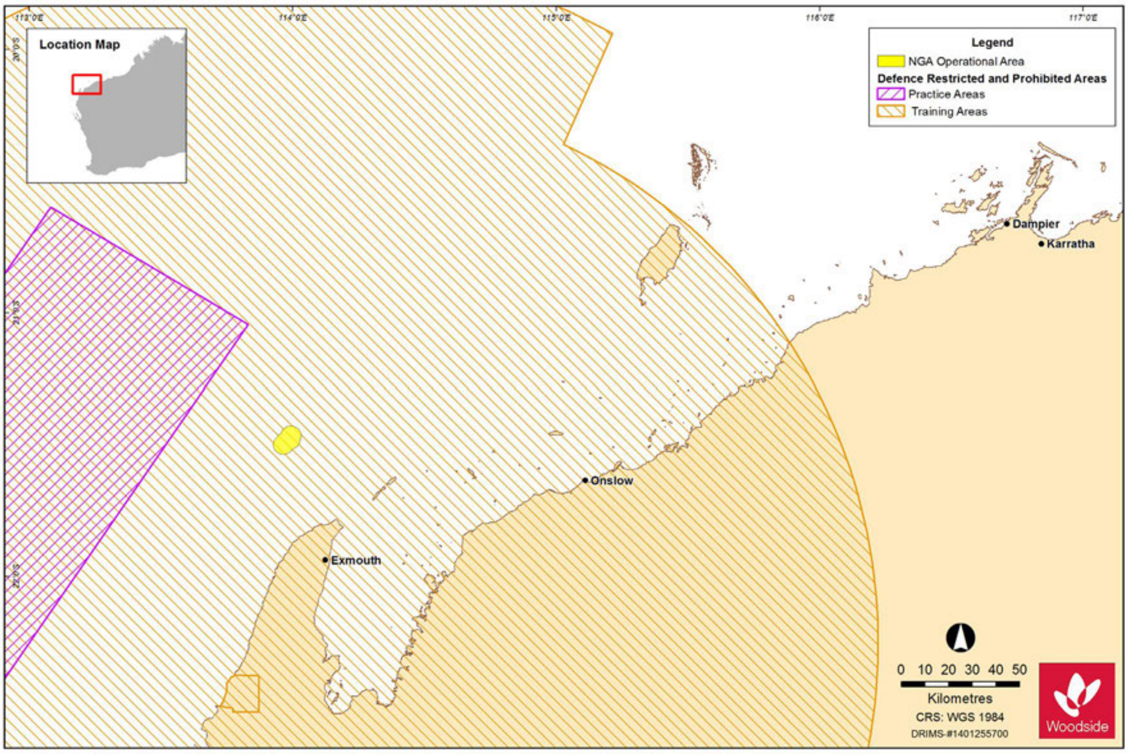
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.6 Defence map sent to DoD – 10 October 2019



1.7 Email sent to adjacent titleholders – AWE, BHP and Santos – 10 October 2019

Dear [redacted]

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of adjacent titles relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	  • 500 m radius around the riser turret mooring
	  • 4000 m radius around all wells
	  • 500 m around all flowlines

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

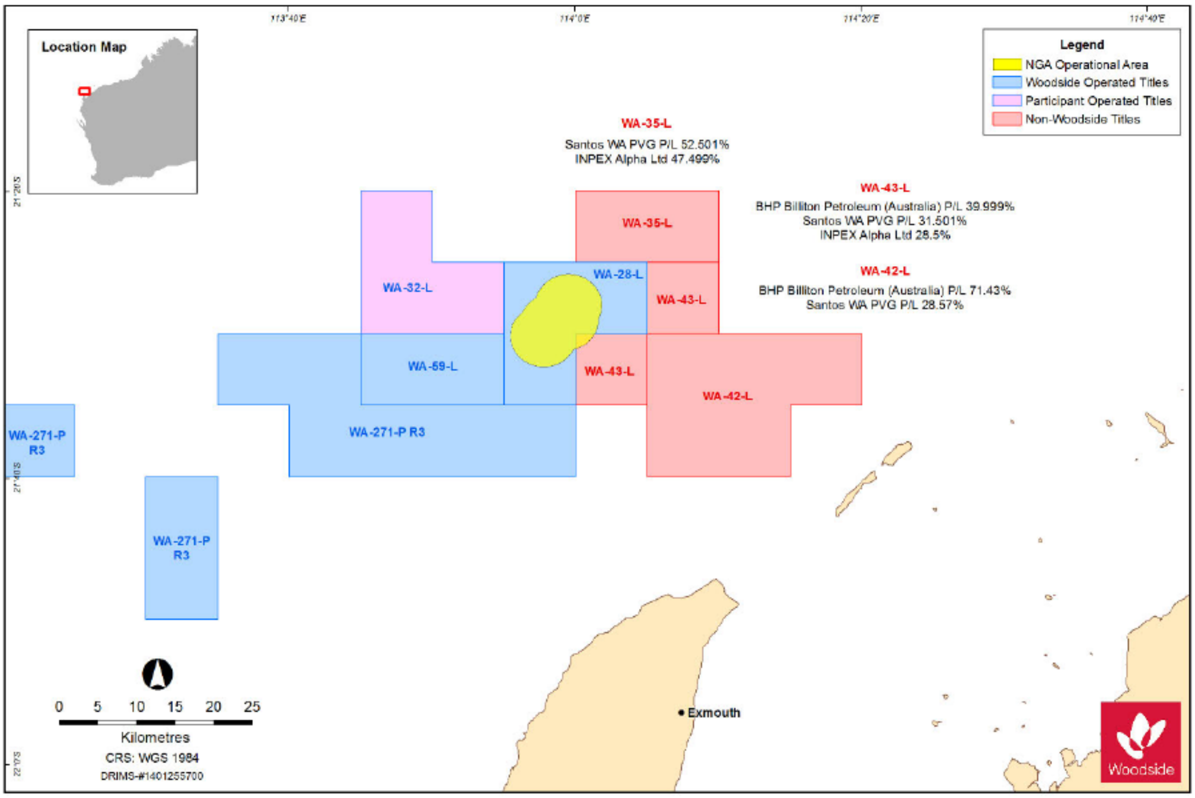
Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.
Regards

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.8 Titles map sent to adjacent titleholders – BP Developments and Mobil Australia – 10 October 2019



1.9 Email sent to DAWR – 10 October 2019

Dear Department of Agriculture and Water Resources

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.

Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels or MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	    ◦ 500 m radius around the riser turret mooring
	    ◦ 4000 m radius around all wells
	    ◦ 500 m around all flowlines

Commercial fishing
Whilst three Commonwealth Fisheries overlap the proposed Operational Area (see attached map), it is our assessment that these fisheries have not been active in the Operational Area in the last five years.

Biosecurity
With respect to the biosecurity matters, please note the following information below.

Vessels:	• Three types of vessels may be utilised to undertake the activity
	    ◦ Well intervention vessel
	    ◦ Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU)
	    ◦ Support vessels, including anchor handling vessels, installation vessels and activity support vessels
	• All vessels are required to undergo a Woodside Marine Assurance Inspection to review compliance with marine laws and Woodside safety and environmental requirements.
	• Support vessels may be sourced from the local area (Dampier, Karratha, etc) or from further afield, depending on the type of vessel required and availability

Environment description:	• The seabed around Nganhurra facility is relatively flat and featureless although the western end of the Operational Area overlaps the Enfield Escarpment. The Enfield Escarpment is approximately 50 m in height, with a relatively steep slope in comparison to the surrounding seabed. The Enfield canyon lies in the southern portion of the Operational Area and comprises the North and South Enfield Canyons, which is a part of the Key Ecological Feature (KEF). • The closest distance to the Marine Parks are

	◦ Approximately 15 km north west of the Commonwealth boundary of the Ningaloo Marine Park ◦ Approximately 15 km north of the Gascoyne Commonwealth Marine Reserve ◦ Approximately 30 km north west of the Muiron Islands Marine Management and Conservation Area
Ballast and biofouling management:	• Compliance with National Ballast Water and Biofouling Management Requirements (as defined under the *Biosecurity Act 2015*). • Requirements are aligned with the International Convention for the Control and Management of Ships' Ballast Water and Sediments and the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry. • As a minimum, all vessels mobilised from outside of Australia will undertake ballast water exchange > 12 nm from land and > 50 m water depth. • The operator of a vessel must provide a ballast water report if it is intended that the vessel discharge, or the vessel discharges, ballast water in Australian seas.
IMS risk:	• Introduction or translocation and establishment of invasive marine species to the area via vessels or biofouling. • Introducing invasive marine species into the local marine environment will alter the ecosystem, as invasive species have characteristics that make them superior (in a survival and/or reproductive sense) to the indigenous species. • Invasive marine species have also proven economically damaging to areas where they have been introduced and established.
IMS mitigation:	• Vessels will be assessed and managed to prevent the introduction of invasive marine species in accordance with Woodside's Invasive Marine Species Management Plan. • Woodside's Invasive Marine Species Management Plan includes a risk assessment process that is applied to vessels undertaking Activities. Based on the outcomes of each IMS risk assessment, Management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced. • Vessels are required to comply with the *Australian Biosecurity Act 2015.*

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

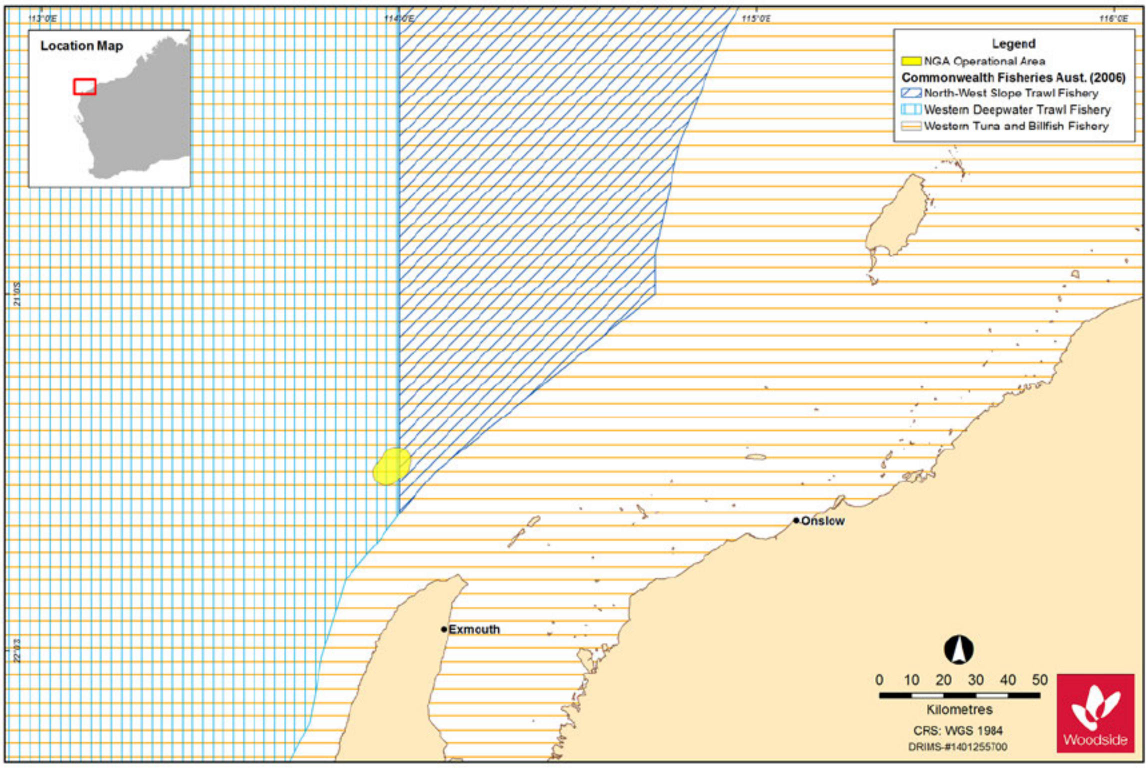
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.10 Commonwealth Fisheries map sent to DAWR – 10 October 2019



1.11 Email sent to Exmouth Community Reference Group – 9 October 2019

Dear Exmouth Community Reference Group

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field

	• Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels
Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring • A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities • The following new Operational Areas will also apply for the duration of activities: □ 500 m radius around the riser turret mooring □ 4000 m radius around all wells □ 500 m around all flowlines

Your feedback
Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 8 November 2019 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.12 Presentation slide at Community Reference Group meeting – 7 November 2019

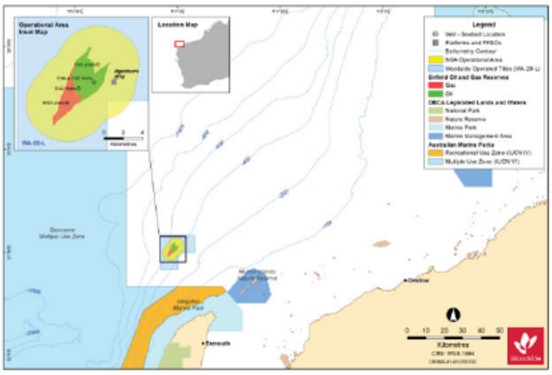
PROJECTS

Nganhurra Operations Cessation Environment Plan

+ Preparing for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility.
+ Information sheet sent to the CRG in October, with feedback requested by 8 November.

Activity

+ Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field.
+ Removal of the RTM between Q4 2020 – Q1 2022
+ Well intervention activities in preparation for plug and abandonment may commence from 2021, a 500 m zone would be in place around the vessel.



Experience the Energy | 1 November 2019 6

1.13 Email sent to Exmouth Game Fishing Club – 10 October 2019

Dear [redacted]

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m

Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels
Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring • A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities • The following new Operational Areas will also apply for the duration of activities: · 500 m radius around the riser turret mooring · 4000 m radius around all wells · 500 m around all flowlines

Your feedback
Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.14 Email sent to Exmouth-based charter boat, tourism and dive operators – 10 October 2019

Dear stakeholder

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
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Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	  ◦ 500 m radius around the riser turret mooring
	  ◦ 4000 m radius around all wells
	  ◦ 500 m around all flowlines

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.
Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.15 Email sent to AMSA (marine safety) and AHO – 10 October 2019

Dear stakeholder

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.
A map of shipping lanes relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	    • 500 m radius around the riser turret mooring
	    • 4000 m radius around all wells
	    • 500 m around all flowlines

Your feedback
Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

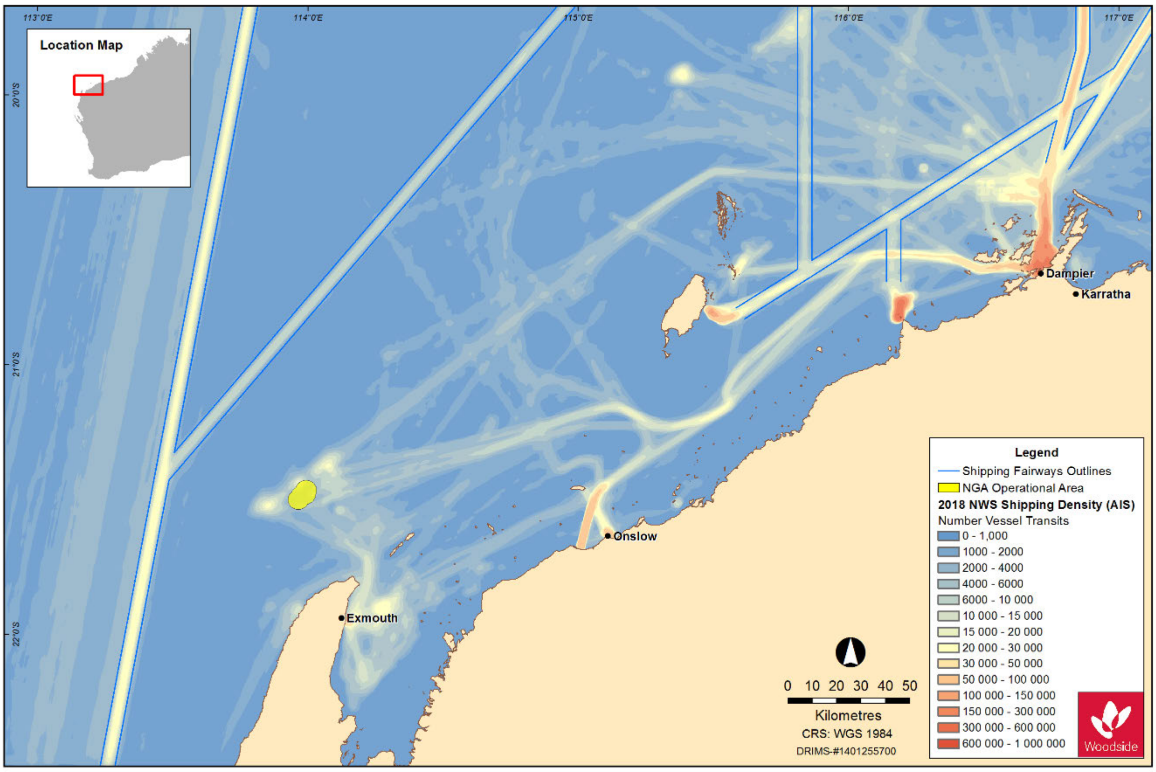
Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.
Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.16 Shipping fairways map sent to AMSA (marine safety) and AHO – 10 October 2019



1.17 Email sent to AMSA (marine pollution) and DoT – 10 October 2019

Dear [redacted]

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

We will provide a copy of our Oil Pollution First Strike Plan once planning is finalised.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field • Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels
Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring • A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities • The following new Operational Areas will also apply for the duration of activities: · 500 m radius around the riser turret mooring · 4000 m radius around all wells · 500 m around all flowlines

Your feedback
Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **8 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.18 Email sent to DoT with first strike plan – 30 October 2019

Good Morning [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 *NGA Operations Cessation Environment Plan* and would like to offer DoT the opportunity to review or provide comment on the activity.

Information is presented as follows:

- A Consultation Information Sheet is available on our website here, providing information on the proposed petroleum activities program.
- The *Nganhurra Cessation of Operations Oil Pollution First Strike Plan* is attached. This will form part of the approval submission in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).
- In the table below, as requested in the *Offshore Petroleum Industry Guidance Note* (September 2018) and from recent engagement activities between DoT-Woodside, responses to the information requirements in a succinct summary and source of information.

Woodside propose to submit an EP 20th December 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 29th November to allow us sufficient time to inform our activity planning and EP development.

Comments can be made by email, letter or by phone.

Please be aware that your feedback will be communicated to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under legislation.

We look forward to hearing from you.

[redacted]

Information Requested in the Offshore Petroleum Industry Guidance Note (September 2018)	Information Provided & Reference
Description of activity, including the intended schedule, location	Included in the consultation information sheet

(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 testing on Enfield crude indicates that average dispersant efficiency (%) for oil age will be; • ~42% (0 hrs) • ~44% (24 hrs) • ~50% (96 hrs) • ~54% (>240 hrs) This data is based on a range of weathering results and five (5) National Plan OSCA approved an/or transitional dispersants that will be the selected dispersant used by Woodside.	
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. Five unplanned events or credible spill scenarios for the Petroleum Activities Program have been selected as representative across types, sources and incident/response levels, up to and including the WCCS. Table 2-1 of the OSPRMA presents the credible scenarios for the Petroleum Activities Program. Two WCCS for the activity are then used for response planning purposes as all other scenarios are of a lesser scale and extent. By demonstrating capability to meet and manage an event of this size, Woodside assumes relevant scenarios that are smaller in nature and scale can also be managed by the same capability. Response performance outcomes have been defined based on a response to the WCCS.	
Outcomes of oil spill trajectory modelling, including predicted times to enter State waters and contact shorelines.	Minimum time to shoreline contact (above 100 g/m2) (loss of well containment – MEE-01)	21 days at Ningaloo Coast – Mangrove Bay (0.882 m3)
	Minimum time to shoreline contact (above 100g/m2) in days (loss of	40.25 days (Pilbara Islands – Southern Islands Group – 0.88 m3)

	well containment – MEE-01)	
	Minimum time to shoreline contact (above 100g/m2) in days (loss of well containment – MEE-01)	54 days (Barrow Island, 6.855 m3)
	Minimum time to shoreline contact (above 100g/m2) in days (loss of well containment – MEE-01)	60 days (Montebello Islands and Montebello Islands State Marine Park – 4.46 m3)
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	
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.	One Level 1 oil spill response exercise to be conducted within two weeks of commencing: • Project activities (i.e. RTM removal). • Each well intervention campaign. The drill will test elements of the recommended response identified in the Nganhurra Operations Cessation Oil Pollution First Strike Plan, in relation to the level of the incident. **Testing of Oil Spill Response Arrangements** There are a number of arrangements which in the event of a spill will underpin Woodside's ability to implement a response across its petroleum activities. In order to ensure each of these arrangements is adequately tested, the Hydrocarbon Spill Preparedness Capability and Competency Coordinator ensures tests are conducted in alignment with the Hydrocarbon Spill Arrangements Testing Schedule (Woodside Doc No. 10058092). Woodside's Hydrocarbon Spill Preparedness & Response Testing Schedule aligns with international good practice for spill preparedness & response management; the testing is compatible with the IPIECA Good Practice Guide and the	

	Australian Emergency Management Institute Handbook. The Hydrocarbon Spill Arrangements Testing Schedule (Woodside Doc No. 10058092) identifies the type of test which will be conducted annually for each arrangement, and how this type will vary over a five year rolling schedule. Testing methods may include (but are not limited to): audits, drills, field exercises, functional workshops, assurance reporting, assurance monitoring and reviews of key external dependencies. Activity specific Oil Spill Pollution First Strike Plans are developed to meet the response needs of that particular activity's Worst Credible Spill Scenario (WCCS). The ability to implement these plans may rely on specific arrangements or those common to other Woodside activities. Regardless of their commonality each arrangement will be tested in at least one of the methods annually. This ensures that personnel are familiar with spill response procedures, reporting requirements, and roles/ responsibilities. 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 sow a reference error in the attached version.

[redacted]
Hydrocarbon Spill Adviser | Security & Emergency Management

1.19 Email sent to AMSA with first strike plan – 1 November 2019

Good Afternoon [redacted]

As part of Woodside's ongoing consultation for its current and planned activities, I would like to advise the Australian Maritime Safety Authority (AMSA) that Woodside are preparing the *Nganhurra Operations Cessation activities Environment Plan* 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.
- The *Nganhurra Cessation of Operations Oil Pollution First Strike Plan* is attached. This will form part of the approval submission in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth). 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

Woodside propose to submit an EP 20 December 2019 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 29 November 2019 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.

Kind Regards

[redacted]

[redacted]
Hydrocarbon Spill Adviser | Security & Emergency Management

1.20 Email sent to Recfishwest – 4 November 2019

Dear [redacted]

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Activities in preparation for future decommissioning of Nganhurra FPSO infrastructure
Activity:	• Disconnection of riser turret mooring lines from the Nganhurra facility's riser turret mooring and removal of the riser turret mooring from the field

	• Well intervention in preparation for permanent plugging of the existing 18 development wells
Activity location:	• 38 km North West of Exmouth, Western Australia.
Approximate water depth:	• 400 m – 550 m
Earliest commencement date:	• Between Q4 2020 and Q1 2022 for the removal of the riser turret mooring • From 2021 for well activities, depending on rig availability
Estimated duration:	• 30 days for the removal of the riser turret mooring • 10-20 days per well for well intervention
Vessels:	• Well intervention vessel • Moored or dynamically positioned semi-submersible mobile offshore drilling unit (MODU) • Support vessels, including anchor handling vessels, installation vessels and activity support vessels

Exclusion zones:	• An existing 500 m radius petroleum safety zone around the riser turret mooring
	• A new and temporary 500 m radius petroleum safety zone around the intervention vessels and MODU whilst in the field for the duration of activities
	• The following new Operational Areas will also apply for the duration of activities:
	  ◦ 500 m radius around the riser turret mooring
	  ◦ 4000 m radius around all wells
	  ◦ 500 m around all flowlines

Your feedback
Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **3 December 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.21 Email sent to Recfishwest – 4 December 2019

Hi [redacted] – as just discussed, attached and below is information regarding the Nganhurra Operations Cessation EP Revision.

Should you have any comments / feedback please let me know by 6 December.

Thanks

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

1.22 Email sent to DNP – 22 November 2019

Dear Director of National Parks

Woodside is planning to undertake petroleum activities in production licence WA-28-L off the North West Cape in preparation for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility, which ceased production and left the field in 2018.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

We note Australian Government Guidance on consultation activities with respect to the proposed activities and confirm that:

- The proposed activities are outside the boundaries of a proclaimed Australian Marine Parks, with activities taking place approximately 15 km north west of the Commonwealth boundary of the Ningaloo Marine Park and approximately 15 km north of the Gascoyne Commonwealth Marine Reserve.
- We have assessed potential risks to Australian Marine Parks in the development of the proposed Environment Plan for this activity and believe that there are no credible risks as part of planned activities that have potential to impact the values of the Marine Parks.
- The worst case credible spill scenario assessed in this EP is the remote likelihood event of a subsea well blow-out. For this to occur, the Xmas Tree on top of the well must be completely removed along with the failure of multiple barriers within the well. Given the controls in place to prevent and control loss of containment events, it is considered that the risk associated with a subsea well blow-out is managed to as low as reasonably practicable.
- In the highly unlikely event of a loss of well control there is a risk of a small volume of light crude entering the following Marine Parks:
  - Ningaloo
  - Gascoyne
  - Montebello (social cultural EMBA overlap only)
  - Shark Bay
  - Carnarvon Canyon
  - Abrolhos
  - Argo-Rowley Terrace (social cultural EMBA overlap only)

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 the Marine Park.

For information, a Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Please contact me if you have any feedback on the proposed activity by close of business **16 December 2019**, noting that 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).

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

2. Additional Consultation

2.1 Email sent to relevant stakeholders

Woodside sent the email below and consultation Information Sheet below to:

- *APPEA*
- *Australian Customs Service*
- *DISER*
- *DMIRS*
- *DBCA*
- *Recfishwest*
- *DoT*
- *Exmouth based charter boat, tourism and dive operators*
- *Marine Tourism Association of WA*
- *WA Game Fishing Association*

Dear Stakeholder

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.2 Woodside Consultation Information Sheet

Woodside

STAKEHOLDER CONSULTATION
INFORMATION SHEET
ADDITIONAL INFORMATION

July 2020

NGANHURRA OPERATIONS CESSATION ENVIRONMENT PLAN REVISION

EXMOUTH PLATEAU SUB-BASIN, NORTH-WEST AUSTRALIA

Woodside is preparing to remove the Nganhurra Riser Turret Mooring (RTM) from Production Licence WA-28-L between December 2020 and March 2021 (for project completion by approximately the end of April 2021) as part of the Nganhurra Operations Cessation Environment Plan Revision.

After a comprehensive evaluation of options, including repairs to allow the originally proposed onshore disposal of the RTM; and following consultation by Recfishwest, Woodside is proposing to re-purpose the RTM as a deep-water integrated artificial reef in 150 m water depth, around 16 km off the North West Cape.

Recfishwest will apply for a permit for the integrated artificial reef under the *Environment Protection (Sea Dumping) Act 1981* (Cth) which will include the RTM and new purpose-built reef modules. Recfishwest has consulted relevant stakeholders as part of the permit application which has found support for or non-objection to the proposed reef location.

Based on studies and community feedback provided to Recfishwest, integrated artificial reefs increase fish productivity and environmental resilience, provide an economic stimulus for regional communities, and enhance and provide accessible fishing experiences.

Woodside will concurrently seek approval to dispose of the RTM at a deep-water location should the artificial reef option not be approved.

Woodside has included these options in the Nganhurra Operations Cessation Environment Plan Revision. Stakeholders have already been consulted on other activities to be undertaken under the revised Environment Plan.

The RTM will be removed from Production Licence WA-28-L which is held by Woodside Energy Ltd (Operator and 60% interest) and Mitsui E&P Australia Pty Ltd (40% interest).

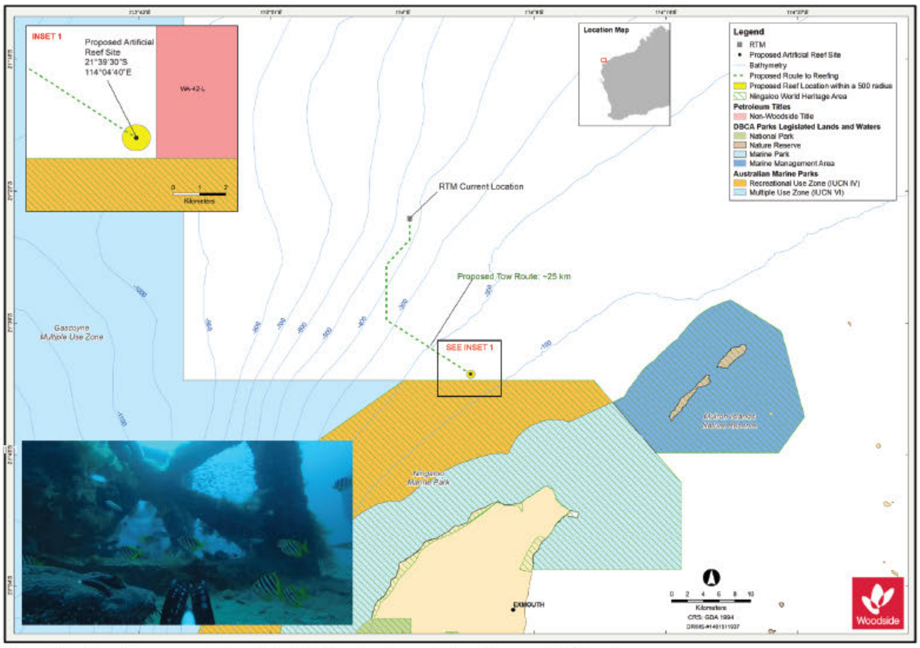


Figure 1. Location of the proposed integrated artificial reef and tow route from the current RTM location

1 Nganhurra Operations Cessation Environment Plan Revision, Exmouth Plateau Sub-basin, North-West Australia – Additional Information Sheet | July 2020

Table 1. Activity summary

Nganhurra RTM activities	Integrated Artificial Reef	Contingency Deepwater Disposal
Commencement dates	+ Between December 2020 and March 2021 for the preparation, removal, tow and placement of the RTM onto the seafloor (completion of the project targeted by the end of April 2021).	
Approximate estimated duration	+ 15-25 days on site for the removal of the RTM including preparation, short tow, placement on the seafloor, and installation of purpose-built reef modules.	+ 15-25 days on site for the removal of the RTM including preparation, long tow and placement on the seafloor.
Location	+ 21°39'30"S, 114°04'40" E	+ 19°52'45"S, 111°40'30"E
Distance to Exmouth	+ ~16 km north-west of Exmouth	+ ~350 km north-west of Exmouth
Distance to nearest marine park	+ Greater than ~300 m from Ningaloo Australian Marine Park (and associated cultural heritage areas) + ~9.5 km Ningaloo State Marine Park + ~17 km from Muiron Islands Marine Management Area	+ ~90 km north of the Gascoyne Commonwealth Marine Reserve + ~320 km Ningaloo State Marine Park + ~330 km from Muiron Islands Marine Management Area
Water depth	+ ~150 m	+ ~2,000 m
Project vessels	+ Anchor handling tugs + Installation vessel	
Exclusion zones	+ A temporary 500 m operational exclusion zone will apply during tow and placement activities. + No exclusion zones will apply once the RTM is on the seafloor.	

About the Riser Turret Mooring

The RTM houses the risers which connected subsea infrastructure to the Nganhurra Floating Production, Storage and Offloading (FPSO) facility. Oil was transferred from the wells and subsea infrastructure via flowlines to the flexible risers within the RTM. The RTM is still at its original location. The FPSO sailed away in late 2018.

The RTM is approximately 83 m in length and between 4.5 m and 8.5 m in diameter below the sea surface and 12.5 m above the sea surface. It sits approximately 6.5 m above the sea surface and is anchored to the seabed by three sets of three mooring chains.

The RTM has been tested for contaminants, and contains no Naturally Occurring Radioactive Materials (NORMs) or mercury. An Invasive Marine Species (IMS) inspection has found no IMS of concern. The RTM contains foam in the top compartment to assist in buoyancy.

The RTM hull is steel (S350). The risers and EHU comprise of multi-layered steel and plastic. Iron ore (400 tonnes) was added as ballast in the bottom compartment of the RTM. The RTM is coated in marine paint, has sacrificial anodes, and contains ~50 liters of hydraulic fluid.

Under the previously accepted Environment Plan, Woodside planned to disconnect, re-ballast to a horizontal position, and tow the RTM to Henderson, Western Australia for onshore disposal. During preparation activities, it was found that one of the RTM's main ballast compartments could not be re-ballasted to allow removal of the RTM for onshore disposal as planned.

An assessment of other options to decommission the RTM, including repairing and towing, and different scenarios to lift the 2,500 tonne RTM using various specialised vessels for transport to shore, was undertaken. These options present significant technical feasibility and safety challenges.

An assessment of offshore disposal options found preparing and placing the RTM on the seafloor as part of an integrated artificial reef provides social, economic, and environmental benefits, such as a recreational fishing amenity and accessibility, increased fish productivity and environmental resilience, and an economic stimulus to the region. It also reduces safety risks, removes extended tow risks, and is technically viable.

Figure 2. Profile of the RTM

Exmouth Artificial Reef

Woodside proposes to prepare the RTM and repurpose it as part of an integrated artificial reef consisting of the RTM and new purpose built reef modules.

Site work at the current RTM location will include removal and recovery of the riser bend stiffeners and riser tail stubs, flushing residual hydraulic fluid and chemicals, removing ancillary items on top of the RTM, and disconnecting the RTM from its moorings.

The RTM will then be towed approximately 25 km in a vertical position using an anchor handling tug and assisting tug to the artificial reef site. The tow route will avoid marine parks, existing subsea and surface infrastructure, and where possible other petroleum permits.

Site work at the reef location will then include placing the RTM on the seafloor in a horizontal position by flooding ballast compartments in a controlled manner, stabilising the RTM once in position, and encapsulating the foam within the top compartment of the RTM to prevent the foam from dispersing into the marine environment.

Around 24 large purpose built concrete reef modules (around 4 m x 4 m x 5 m in size) and 24 small modules (around 2.1 m round x 1.8 m high in size) will be installed using an installation vessel around the RTM on the seafloor. A video survey of the integrated artificial reef site will then be performed. Ongoing reef monitoring will then be undertaken by Recfishwest for around the next 30 years.

The identified location for the reef is within a 500m radius area with a centre point – 21°39'30"S, 114°04'40"E. The location has been selected based on consultation by Recfishwest, as the permit applicant for the deep-water integrated artificial reef (under the *Environment Protection (Sea Dumping) Act 1981* (Cth)), and a seabed survey completed which showed a featureless and sandy seafloor. The footprint of the reef will be a maximum of 300m x 300m (Figure 3) located within the 500m radius.

Activities for the RTM removal are expected to take around 15-25 days and commence between December 2020 and March 2021 subject to approval (completion of the project is targeted prior to the end of April 2021). Exact commencement within this timeframe and activity duration will be dependent on weather, vessel availability and any unforeseen circumstances. If unable to meet this commencement window, the activities will be undertaken between December 2021 and March 2022 (next suitable weather window).

Recfishwest worked with the recreational fishing community of Exmouth to decide on the reef concept, purpose, design and location. The final reef location was selected following consultation with broader stakeholders.

Stakeholders consulted are either supportive of, or have no-objections to, the proposed integrated artificial reef location. Outcomes of the consultation will be included in the permit application, taking into account environmental and societal considerations. This consultation builds on Recfishwest's extensive and ongoing stakeholder engagement for its activities in the Exmouth region.

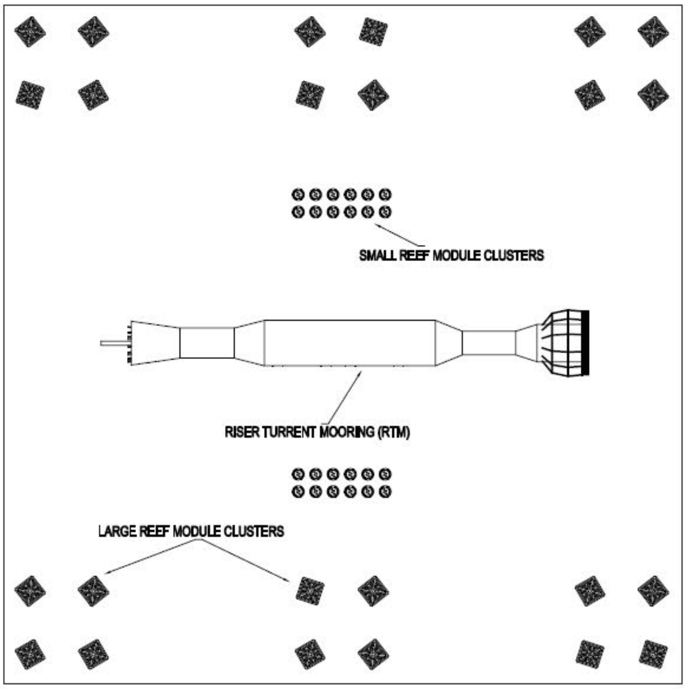


Figure 3. Proposed layout of the integrated artificial reef (maximum area of 300 m x 300 m)

Composition of Infrastructure used in Integrated Artificial Reefs

Repurposing infrastructure like the RTM into an integrated artificial reef is not a new concept. An example are ships which are purposefully sunk to create dive wrecks, marine habitat and for fishing purposes. Similarities include:

- Surface Coatings - Paints, resins, or other substances applied to the surfaces of the ships including copper based antifoulant paint, and zinc epoxy primer. The antifoulant paint on the RTM has depleted and is no longer effective with marine life now growing on the RTM.
- Mixture of mineral and water based hydraulic fluid - Approximately 50 litres of hydraulic fluid (Tellus 32 and HW525) contained within the RTM ballast system will remain when reefed or deep water disposed, similar to residual fuel storage compartments in ships. Dispersion modelling of the hydraulic fluid has shown that over time this will eventually release and disperse in small droplets.
- Steel – Similar to ships the RTM is constructed of S350 grade steel which will degrade over time.
- Cathodic protection – Aluminum and zinc anodes are used to protect the immersed sections of a ships hull, and have been installed to protect the RTM. These will deplete over time.
- Marine foam – Boats have polyurethane foam added to their hull for buoyancy and insulation. The RTM has marine foam added for buoyancy which will compress under pressure as the RTM is placed on the seafloor. The foam will be secured and captured with in the compartment by a non-degradable product (e.g. grout) to prevent it escaping into the marine environment.
- Risers, EHU, and bend stiffeners – There are internal components manufactured from steel and plastics that will remain inside the RTM. The risers have been flushed and are hydrocarbon-free, and the EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed. The bend stiffeners, riser and EHU stubs extrude external to the RTM and will be cut off. For the reef option the ends of the risers and EHU will be encapsulated in grout (cement – a non-degradable product) to prevent the plastic from being exposed to the marine environment. Also, 'windows' in the external hull of the RTM to the risers and EHU (at the inter-tidal section) will be managed to minimise the exposure to the marine environment.

Deepwater Disposal

A contingency option of deep-water disposal is being carried. The contingency is to tow the RTM around 367 km using an anchor handling tug and assisting tug to its proposed disposal location, where an Installation Vessel will be used to place the RTM on the seafloor in 2,000 m of water. Previous seabed video imagery for the area shows a sandy, featureless seafloor with no sessile marine life.

Preparation at the current RTM location for the deep-water contingency option will be the same as the artificial reef option.

The RTM will then be towed in a vertical position using an anchor handling tug and assisting tug to the deep-water disposal site. The tow route will avoid marine parks, existing subsea and surface infrastructure, and where possible other petroleum permits.

The RTM would then be placed on the seafloor by flooding the ballast compartments in a controlled manner. A survey of the RTM on the seafloor would then be performed.

Communications with mariners

The RTM has an existing 500m exclusion zone which will be removed once it has been disconnected from its moorings.

A temporary 500 m operational exclusion zone will then apply during tow and RTM placement activities. No exclusion zones will apply once the RTM is on the seafloor.

Marine notices will be issued prior to activity commencement to alert vessels which may be operating in waters nearby.

The location of the integrated artificial reef or the deep-water disposal site will be marked on navigational charts.

Implications for Stakeholders

Woodside is consulting relevant stakeholders whose interests, functions, and 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 the planned activities.

A number of mitigation and management measures will be implemented and are summarised in Table 2. Further details will be provided in the revised Environment Plan.

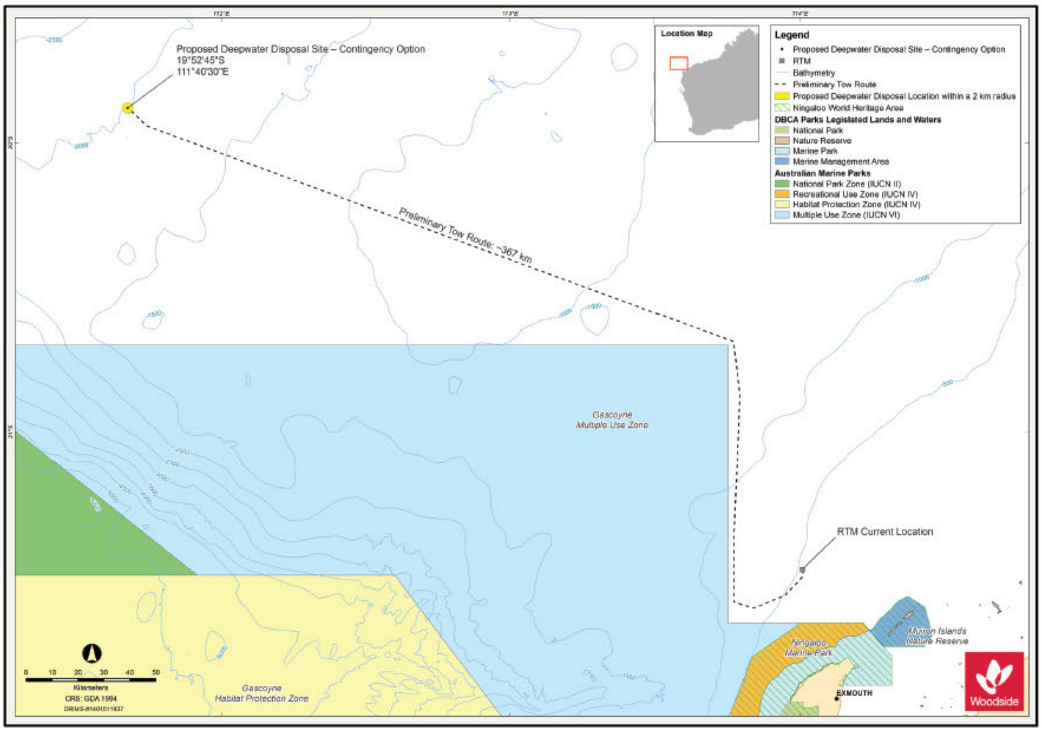


Figure 4. Location of the proposed deep-water disposal location and tow route from the current RTM location

Table 2. Summary of key risks and/or impacts and management measures

Potential Risk and/or Impact	Mitigation and/or Management Measure
Planned	
Interests of relevant stakeholders including: + Defence and 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 to inform decision making for the proposed activity and development of the revised Environment Plan. + Advice to relevant stakeholders prior to the commencement of activities.
Marine fauna interactions	+ Vessel masters will implement interaction management actions in accordance with the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). + Implementation of the Woodside Exmouth Gulf Vessel Management Plan.
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	+ Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity. + Stakeholder engagement activities as part of the revised Environment Plan.
Seabed disturbance	+ Placement of the RTM will be within a 500m radius area. + The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower modules) to be appropriately stabilised. + Limited and localised seabed impacts offset by long-term benefits of the artificial reef. + No anchoring of tug or installation vessels.
Vessel interaction	+ Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on-location dates and any exclusion zones prior to commencement of the activity. + A 500m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains. + A temporary 500 m exclusion zone will apply during tow and RTM placement activities.
Waste generation	+ Waste generated on the vessels will be managed in accordance with legislative requirements and a Waste Management Plan. + Wastes will be managed and disposed of in a safe and environmentally responsible manner that prevents accidental loss to the environment. + Wastes transported onshore will be sent to appropriate recycling or disposal facilities by a licensed waste contractor.
Unplanned	
Hydrocarbon release (project vessels)	+ Appropriate spill response plans, equipment and materials will be in place and maintained. + Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment.
Introduction of invasive marine species	+ All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. + Compliance with Australian biosecurity requirements and guidance.
Seabed disturbance (loss of RTM on tow)	+ Tow route planned to not overlap sensitive marine environments, or petroleum titles where possible. + Consideration to recover lost objects on the seafloor.
Disturbance to other marine users (loss of control of RTM during tow)	+ All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. + Compliance with Australian biosecurity requirements and guidance.
Discharges of residual RTM contaminants - Reef option only	+ EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed. + Bend stiffeners and riser stubs removed. + The foam will be encapsulated within the compartment of the RTM to prevent it from escaping into the marine environment. + Encapsulate exposed cut end of risers and EHU. + 'Windows' in the external hull of the RTM to the risers and EHU will also be managed to minimise the exposure to the marine environment.

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 **24 July 2020**.

Please note that your feedback and our response will be included in our revised 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 revised Environment Plan in order for this information to remain confidential to NOPSEMA.

Andrew Winter
Senior 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

2.3 Email sent to DPIRD – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

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. Further information is below.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of relevant fisheries is also attached.

Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube and AFMA data), fishing methods, water depth, and the likelihood of fishing in the future.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m

Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel
Relevant Commonwealth Fisheries	• No Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years. • We will consult the following Commonwealth Fisheries based on the chance for vessel interaction over the RTM tow routes or possible future fishing at the reef location with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.	• No Commonwealth Fisheries have actively fished over the deep-water disposal location in the last 5 years. • There may be a chance for vessel interaction over the RTM tow routes with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries. • Given water depth no future fishing is expected for this option.
Relevant State Fisheries (to be consulted):	• Pilbara Line Fishery	• None
Assessment of other overlapping State Fisheries (won't be consulted):	The following State fisheries overlap the operational areas but are not considered relevant and will not be consulted on the following assessment: • Mackerel Managed Fishery (Area 2) - While the tow route overlaps the fishery, fishers will not be active based on the distribution of target species (Spanish Mackerel), surface trolling fishing methods and the water depth of the artificial reef and deepwater disposal (previous advice from WAFIC that fishers are only active at water depths less than 70 m). • South West Coast Salmon Fishery - While the tow route overlaps the fishery, based on the State of the Fisheries Report and previous advice from WAFIC no fishing takes place north of the Perth metropolitan area, and occurs as net fishing from the shore. • Western Coast Deep Sea Crustacean Managed Fishery - In recent years fishing has only been undertaken along the continental shelf edge and in waters south of Exmouth (West Coast Deep Sea Crustacean Managed Fishery, DPIRD 2005). Fishery uses baited pots in a long-line formation in shelf edge	

	waters greater than 150 m (State of the Fisheries Report). • Pilbara Crab Managed Fishery – While the tow route overlaps the fishery, it is over an area closed to fishing, and target species (blue swimmer crab) are found in waters up to 50 m deep (DPIRD). • WA Sea Cucumber Fishery – While the tow route overlaps the fishery it is a dive and wade fishery with activities generally restricted to less than 30 m water depth (previous engagement with WAFIC).

Potential risks to commercial fishing and proposed mitigation measures:

POTENTIAL RISK	RISK DESCRIPTION	MITIGATION AND/OR MANAGEMENT MEASURES
Planned		
Vessel interaction:	• The presence of vessels may preclude other marine users from access to the area	• Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on location dates and any exclusion zones prior to commencement of the activity • A 500 m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains • A temporary 500 m exclusion zone will apply during tow and RTM placement activities
Seabed disturbance:	• Disturbance to the seabed from placement of the RTM	• Placement of the RTM will be will be within a 500 m radius area for the artificial reef, and 2 km for the deepwater disposal • The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower modules) to be appropriately stabilised • Limited and localised seabed impacts offset by

		long-term benefits of the artificial reef • No anchoring of tug or installation vessels
Underwater noise:	• Noise will be generated by project 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
Marine discharges:	• Discharges from the operation of project vessels may include sewage, grey water, drain and bilge water, cooling water and brine. These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column	• 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:	• Physical presence of infrastructure on the seafloor causing interference / displacement	• Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity • Stakeholder engagement activities as part of the revised Environment Plan
Unplanned Risks		
Hydrocarbon release (project vessels)	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Appropriate spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species

		• Compliance with **Australian** biosecurity requirements and guidance
Seabed disturbance (loss of RTM on tow)	• Disturbance to the seabed from loss of control and sinking of the RTM during tow	• Tow routes planned to not overlap sensitive marine environments, or petroleum titles where possible • Consideration to recover lost objects on the seafloor
Disturbance to other marine users (loss of control of RTM during tow)	• Disturbance or restrictions for other marine users in certain areas should the RTM be lost during tow	• Spare tow rope carried onboard • Standby vessel accompanies the RTM during tow
Discharges of residual RTM contaminants	• Contaminants discharge to the environment	• The risers have been flushed and are hydrocarbon-free • EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed • Bend stiffeners and riser stubs removed • Secured and capture the foam within the compartment of the RTM to prevent it from escaping into the marine environment • Encapsulate exposed cut end of risers and EHU.

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations

Woodside Energy Ltd

2.4 Email sent to WAFIC – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

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. Further information is below.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of relevant fisheries is also attached.

Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube and AFMA data), fishing methods, water depth, and the likelihood of fishing in the future.

Individual licence holders will be advised following your consideration of this information.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E	• 350 km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021

Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel
Relevant Commonwealth Fisheries	• No Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years. • We will consult the following Commonwealth Fisheries based on the chance for vessel interaction over the RTM tow routes or possible future fishing at the reef location with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.	• No Commonwealth Fisheries have actively fished over the deep-water disposal location in the last 5 years. • There may be a chance for vessel interaction over the RTM tow routes with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries. • Given water depth no future fishing is expected for this option.
Relevant State Fisheries (to be consulted):	• Pilbara Line Fishery	• None
Assessment of other overlapping State Fisheries (won't be consulted):	The following State fisheries overlap the operational areas but are not considered relevant and will not be consulted on the following assessment: • Mackerel Managed Fishery (Area 2) - While the tow route overlaps the fishery, fishers will not be active based on the distribution of target species (Spanish Mackerel), surface trolling fishing methods and the water depth of the artificial reef and deepwater disposal (previous advice from WAFIC that fishers are only active at water depths less than 70 m). • South West Coast Salmon Fishery - While the tow route overlaps the fishery, based on the State of the Fisheries Report and previous advice from WAFIC no fishing takes place north of the Perth metropolitan area, and occurs as net fishing from the shore. • Western Coast Deep Sea Crustacean Managed Fishery - In recent years fishing has only been	

	undertaken along the continental shelf edge and in waters south of Exmouth (West Coast Deep Sea Crustacean Managed Fishery, DPIRD 2005). Fishery uses baited pots in a long-line formation in shelf edge waters greater than 150 m (State of the Fisheries Report). • Pilbara Crab Managed Fishery – While the tow route overlaps the fishery, it is over an area closed to fishing, and target species (blue swimmer crab) are found in waters up to 50 m deep (DPIRD). • WA Sea Cucumber Fishery – While the tow route overlaps the fishery it is a dive and wade fishery with activities generally restricted to less than 30 m water depth (previous engagement with WAFIC).

Potential risks to commercial fishing and proposed mitigation measures:

POTENTIAL RISK	RISK DESCRIPTION	MITIGATION AND/OR MANAGEMENT MEASURES
Planned		
Vessel interaction:	• The presence of vessels may preclude other marine users from access to the area	• Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on location dates and any exclusion zones prior to commencement of the activity • A 500 m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains • A temporary 500 m exclusion zone will apply during tow and RTM placement activities
Seabed disturbance:	• Disturbance to the seabed from placement of the RTM	• Placement of the RTM will be will be within a 500 m radius area for the artificial reef, and 2 km for the deepwater disposal • The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower

		modules) to be appropriately stabilised • Limited and localised seabed impacts offset by long-term benefits of the artificial reef • No anchoring of tug or installation vessels
Underwater noise:	• Noise will be generated by project 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
Marine discharges:	• Discharges from the operation of project vessels may include sewage, grey water, drain and bilge water, cooling water and brine. These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column	• 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:	• Physical presence of infrastructure on the seafloor causing interference / displacement	• Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity • Stakeholder engagement activities as part of the revised Environment Plan
Unplanned Risks		
Hydrocarbon release (project vessels)	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Appropriate spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Invasive Marine Species	• Introduction or translocation and	• All vessels will be assessed and managed

	establishment of invasive marine species to the area via vessels ballast water or biofouling.	as appropriate to prevent the introduction of invasive marine species • Compliance with **Australian** biosecurity requirements and guidance
Seabed disturbance (loss of RTM on tow)	• Disturbance to the seabed from loss of control and sinking of the RTM during tow	• Tow routes planned to not overlap sensitive marine environments, or petroleum titles where possible • Consideration to recover lost objects on the seafloor
Disturbance to other marine users (loss of control of RTM during tow)	• Disturbance or restrictions for other marine users in certain areas should the RTM be lost during tow	• Spare tow rope carried onboard • Standby vessel accompanies the RTM during tow
Discharges of residual RTM contaminants	• Contaminants discharge to the environment	• The risers have been flushed and are hydrocarbon-free • EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed • Bend stiffeners and riser stubs removed • Secured and capture the foam within the compartment of the RTM to prevent it from escaping into the marine environment • Encapsulate exposed cut end of risers and EHU.

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.5 Email sent to Pearl Producers Association – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 400 km off the North West Cape should the artificial reef not be approved.

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. Further information is below.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of relevant fisheries is also attached.
Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube and AFMA data), fishing methods, water depth, and the likelihood of fishing in the future.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days

Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel
Relevant Commonwealth Fisheries:	• No Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years. • We will consult the following Commonwealth Fisheries based on the chance for vessel interaction over the RTM tow routes or possible future fishing at the reef location with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.	• No Commonwealth Fisheries have actively fished over the deep-water disposal location in the last 5 years. • There may be a chance for vessel interaction over the RTM tow routes with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries. • Given water depth no future fishing is expected for this option.
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	Crustacean Managed Fishery, DPIRD 2005). Fishery uses baited pots in a long-line formation in shelf edge waters greater than 150 m (State of the Fisheries Report). • Pilbara Crab Managed Fishery – While the tow route overlaps the fishery, it is over an area closed to fishing, and target species (blue swimmer crab) are found in waters up to 50 m deep (DPIRD). • WA Sea Cucumber Fishery – While the tow route overlaps the fishery it is a dive and wade fishery with activities generally restricted to less than 30 m water depth (previous engagement with WAFIC).

Potential risks to commercial fishing and proposed mitigation measures:

POTENTIAL RISK	RISK DESCRIPTION	MITIGATION AND/OR MANAGEMENT MEASURES
Planned		
Vessel interaction:	• The presence of vessels may preclude other marine users from access to the area	• Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on location dates and any exclusion zones prior to commencement of the activity • A 500 m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains • A temporary 500 m exclusion zone will apply during tow and RTM placement activities
Seabed disturbance:	• Disturbance to the seabed from placement of the RTM	• Placement of the RTM will be will be within a 500 m radius area for the artificial reef, and 2 km for the deepwater disposal • The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower modules) to be appropriately stabilised

		• Limited and localised seabed impacts offset by long-term benefits of the artificial reef • No anchoring of tug or installation vessels
Underwater noise:	• Noise will be generated by project 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
Marine discharges:	• Discharges from the operation of project vessels may include sewage, grey water, drain and bilge water, cooling water and brine. These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column	• 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:	• Physical presence of infrastructure on the seafloor causing interference / displacement	• Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity • Stakeholder engagement activities as part of the revised Environment Plan
Unplanned Risks		
Hydrocarbon release (project vessels)	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Appropriate spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the	• All vessels will be assessed and managed as appropriate to prevent

	area via vessels ballast water or biofouling.	the introduction of invasive marine species • Compliance with **Australian** biosecurity requirements and guidance
Seabed disturbance (loss of RTM on tow)	• Disturbance to the seabed from loss of control and sinking of the RTM during tow	• Tow routes planned to not overlap sensitive marine environments, or petroleum titles where possible • Consideration to recover lost objects on the seafloor
Disturbance to other marine users (loss of control of RTM during tow)	• Disturbance or restrictions for other marine users in certain areas should the RTM be lost during tow	• Spare tow rope carried onboard • Standby vessel accompanies the RTM during tow
Discharges of residual RTM contaminants	• Contaminants discharge to the environment	• The risers have been flushed and are hydrocarbon-free • EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed • Bend stiffeners and riser stubs removed • Secured and capture the foam within the compartment of the RTM to prevent it from escaping into the marine environment • Encapsulate exposed cut end of risers and EHU.

Feedback:
If you have any issues or concerns with these activities, any other issues relevant to this location then please respond to Woodside at:

feedback@woodside.com.au or +61 438 173 562

Your feedback and our response will be included in our Environment Plan which will be submitted to submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) for acceptance in accordance with the Petroleum (Submerged Lands) (Environment) Regulations 2012 (WA) and the Petroleum Pipelines (Environment) Regulations 2012 (WA).

Please provide your views by 24 July 2020.

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.6 Additional email sent to Pearl Producers Association – 6 July 2020

Hi [redacted]

Further to my email below 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) (not DMIRS as stated below) 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 24 July 2020.

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.7 Email sent to DAWR – 2 July 2020

Dear DAWR

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A Commonwealth Fishery map is also attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E	• 350 km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Commonwealth Fisheries:
No Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years.

We propose to consult the following Commonwealth Fisheries based on the chance for vessel interaction over the RTM tow routes or possible future fishing at the reef location with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.

Biosecurity:
With respect to biosecurity matter, please note the following information below.

Potential IMS risk	IMS mitigation management
• Introduction or translocation and establishment of invasive marine species to the area via biofouling on vessels or within vessels ballast water systems.	• 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.
• Invasive marine species can be environmentally and economically damaging to areas where they have been introduced and established.	• The RTM was inspected in 2018 and no evidence of any IMS was identified. • 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, any other issues relevant to this location then please respond to Woodside at:

feedback@woodside.com.au or +61 438 173 562

Your feedback and our response will be included in our Environment Plan which will be submitted to submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) for acceptance in accordance with the Petroleum (Submerged Lands) (Environment) Regulations 2012 (WA) and the Petroleum Pipelines (Environment) Regulations 2012 (WA).

Please provide your views by **24 July 2020.**
Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.8 Additional email sent to DAWR – 6 July 2020

Dear DAWR

Further to my email below 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) (not DMIRS as stated below) 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 24 July 2020.

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.9 Email sent to AFMA – 2 July 2020

Dear AFMA

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

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. Further information is below.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of relevant fisheries is also attached.

Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube and AFMA data), fishing methods, water depth, and the likelihood of fishing in the future.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel
Relevant Commonwealth Fisheries	• No Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years. • We will consult the following Commonwealth Fisheries based on the chance for vessel interaction over the RTM tow routes or possible future fishing at the reef location with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.	• No Commonwealth Fisheries have actively fished over the deep-water disposal location in the last 5 years. • There may be a chance for vessel interaction over the RTM tow routes with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries. • Given water depth no future fishing is expected for this option.

Potential risks to commercial fishing and proposed mitigation measures:

POTENTIAL RISK	RISK DESCRIPTION	MITIGATION AND/OR MANAGEMENT MEASURES
Planned		
Vessel interaction:	• The presence of vessels may preclude other marine users from access to the area	• Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on location dates and any exclusion zones prior to commencement of the activity • A 500 m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains • A temporary 500 m exclusion zone will apply during tow and RTM placement activities
Seabed disturbance:	• Disturbance to the seabed from placement of the RTM	• Placement of the RTM will be will be within a 500 m radius area for the artificial reef, and 2 km for the deepwater disposal • The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower modules) to be appropriately stabilised • Limited and localised seabed impacts offset by long-term benefits of the artificial reef • No anchoring of tug or installation vessels
Underwater noise:	• Noise will be generated by project 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
Marine discharges:	• Discharges from the operation of project vessels may include sewage, grey water, drain and bilge water, cooling water and brine. These discharges may result in a localised short-term	• All routine marine discharges will be managed according to legislative and regulatory requirements and Woodside's Environmental Performance Standards where applicable

	reduction in water quality however they will be rapidly diluted and dispersed in the water column	
Physical presence of infrastructure:	• Physical presence of infrastructure on the seafloor causing interference / displacement	• Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity • Stakeholder engagement activities as part of the revised Environment Plan
Unplanned Risks		
Hydrocarbon release (project vessels)	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Appropriate spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species • Compliance with **Australian** biosecurity requirements and guidance
Seabed disturbance (loss of RTM on tow)	• Disturbance to the seabed from loss of control and sinking of the RTM during tow	• Tow routes planned to not overlap sensitive marine environments, or petroleum titles where possible • Consideration to recover lost objects on the seafloor
Disturbance to other marine users (loss of control of RTM during tow)	• Disturbance or restrictions for other marine users in certain areas should the RTM be lost during tow	• Spare tow rope carried onboard • Standby vessel accompanies the RTM during tow
Discharges of residual RTM contaminants	• Contaminants discharge to the environment	• The risers have been flushed and are hydrocarbon-free • EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed • Bend stiffeners and riser stubs removed • Secured and capture the foam within the compartment of the

		RTM to prevent it from escaping into the marine environment • Encapsulate exposed cut end of risers and EHU.

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.10 Email sent to Commonwealth Fisheries Association – 2 July 2020

Dear Commonwealth Fisheries Association

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location,
around 350 km off the North West Cape should the artificial reef not be approved.

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. Further information is below.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of relevant fisheries is also attached.

Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube and AFMA data), fishing methods, water depth, and the likelihood of fishing in the future.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel
Relevant Commonwealth Fisheries	• No Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years. • We will consult the following Commonwealth Fisheries based on the chance for vessel interaction over the RTM tow routes or possible future fishing at the reef location with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and	• No Commonwealth Fisheries have actively fished over the deep-water disposal location in the last 5 years. • There may be a chance for vessel interaction over the RTM tow routes with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries. • Given water depth no future fishing is expected for this option.

	Western Skipjack Fisheries.	

Potential risks to commercial fishing and proposed mitigation measures:

POTENTIAL RISK	RISK DESCRIPTION	MITIGATION AND/OR MANAGEMENT MEASURES
Planned		
Vessel interaction:	• The presence of vessels may preclude other marine users from access to the area	• Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on location dates and any exclusion zones prior to commencement of the activity • A 500 m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains • A temporary 500 m exclusion zone will apply during tow and RTM placement activities
Seabed disturbance:	• Disturbance to the seabed from placement of the RTM	• Placement of the RTM will be will be within a 500 m radius area for the artificial reef, and 2 km for the deepwater disposal • The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower modules) to be appropriately stabilised • Limited and localised seabed impacts offset by long-term benefits of the artificial reef • No anchoring of tug or installation vessels
Underwater noise:	• Noise will be generated by project 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
Marine discharges:	• Discharges from the operation of project vessels may include sewage, grey water, drain and bilge water, cooling water and brine. These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column	• 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:	• Physical presence of infrastructure on the seafloor causing interference / displacement	• Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity • Stakeholder engagement activities as part of the revised Environment Plan
Unplanned Risks		
Hydrocarbon release (project vessels)	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Appropriate spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species • Compliance with **Australian** biosecurity requirements and guidance
Seabed disturbance (loss of RTM on tow)	• Disturbance to the seabed from loss of control and sinking of the RTM during tow	• Tow routes planned to not overlap sensitive marine environments, or petroleum titles where possible

		• Consideration to recover lost objects on the seafloor
Disturbance to other marine users (loss of control of RTM during tow)	• Disturbance or restrictions for other marine users in certain areas should the RTM be lost during tow	• Spare tow rope carried onboard • Standby vessel accompanies the RTM during tow
Discharges of residual RTM contaminants	• Contaminants discharge to the environment	• The risers have been flushed and are hydrocarbon-free • EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed • Bend stiffeners and riser stubs removed • Secured and capture the foam within the compartment of the RTM to prevent it from escaping into the marine environment • Encapsulate exposed cut end of risers and EHU.

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.11 Email sent to Fishery Licence Holders (North West Slope and Trawl, Western Tuna and Billfish, Western Deepwater Trawl, Western Skipjack, and Pilbara Line Fishery) – 7 July 2020

Dear Fishery Licence Holder

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

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. Further information is below.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of relevant fisheries is also attached.

Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube and AFMA data), fishing methods, water depth, and the likelihood of fishing in the future.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E	• 350 km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement	• A temporary 500 m operational exclusion zone will apply during tow and placement

	No exclusion zones once on the seafloor	No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel
Relevant Commonwealth Fisheries	• While no Commonwealth Fisheries have actively fished over the proposed reef location in the last 5 years we are consulting (based on potential vessel interaction and possible future fishing at the reef location) with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.	• While no Commonwealth Fisheries have actively fished over the proposed deepwater location in the last 5 years we are consulting (based on potential vessel interaction) with the Western Deepwater Trawl, North West Slope and Trawl, Western Tuna and Billfish, and Western Skipjack Fisheries.
Relevant State Fisheries	• Pilbara Line Fishery	• None

Potential risks to commercial fishing and proposed mitigation measures:

POTENTIAL RISK	RISK DESCRIPTION	MITIGATION AND/OR MANAGEMENT MEASURES
Planned		
Vessel interaction:	• The presence of vessels may preclude other marine users from access to the area	• Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on location dates and any exclusion zones prior to commencement of the activity • A 500 m radius petroleum safety zone will remain in place around the riser turret mooring until it is disconnected from its mooring chains • A temporary 500 m exclusion zone will apply during tow and RTM placement activities

Seabed disturbance:	• Disturbance to the seabed from placement of the RTM	• Placement of the RTM will be will be within a 500 m radius area for the artificial reef, and 2 km for the deepwater disposal • The artificial reef permit or disposal permit requires the RTM (and purpose built reef tower modules) to be appropriately stabilised • Limited and localised seabed impacts offset by long-term benefits of the artificial reef • No anchoring of tug or installation vessels
Underwater noise:	• Noise will be generated by project 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
Marine discharges:	• Discharges from the operation of project vessels may include sewage, grey water, drain and bilge water, cooling water and brine. These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column	• 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:	• Physical presence of infrastructure on the seafloor causing interference / displacement	• Artificial reef and/or RTM marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in its vicinity • Stakeholder engagement activities as part of the revised Environment Plan
Unplanned Risks		

Hydrocarbon release (project vessels)	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Appropriate spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species • Compliance with **Australian** biosecurity requirements and guidance
Seabed disturbance (loss of RTM on tow)	• Disturbance to the seabed from loss of control and sinking of the RTM during tow	• Tow routes planned to not overlap sensitive marine environments, or petroleum titles where possible • Consideration to recover lost objects on the seafloor
Disturbance to other marine users (loss of control of RTM during tow)	• Disturbance or restrictions for other marine users in certain areas should the RTM be lost during tow	• Spare tow rope carried onboard • Standby vessel accompanies the RTM during tow
Discharges of residual RTM contaminants	• Contaminants discharge to the environment	• The risers have been flushed and are hydrocarbon-free • EHU will be flushed of residual production chemicals and hydraulic fluid prior to installation on the seabed • Bend stiffeners and riser stubs removed • Secured and capture the foam within the compartment of the RTM to prevent it from escaping into the marine environment • Encapsulate exposed cut end of risers and EHU.

Feedback:

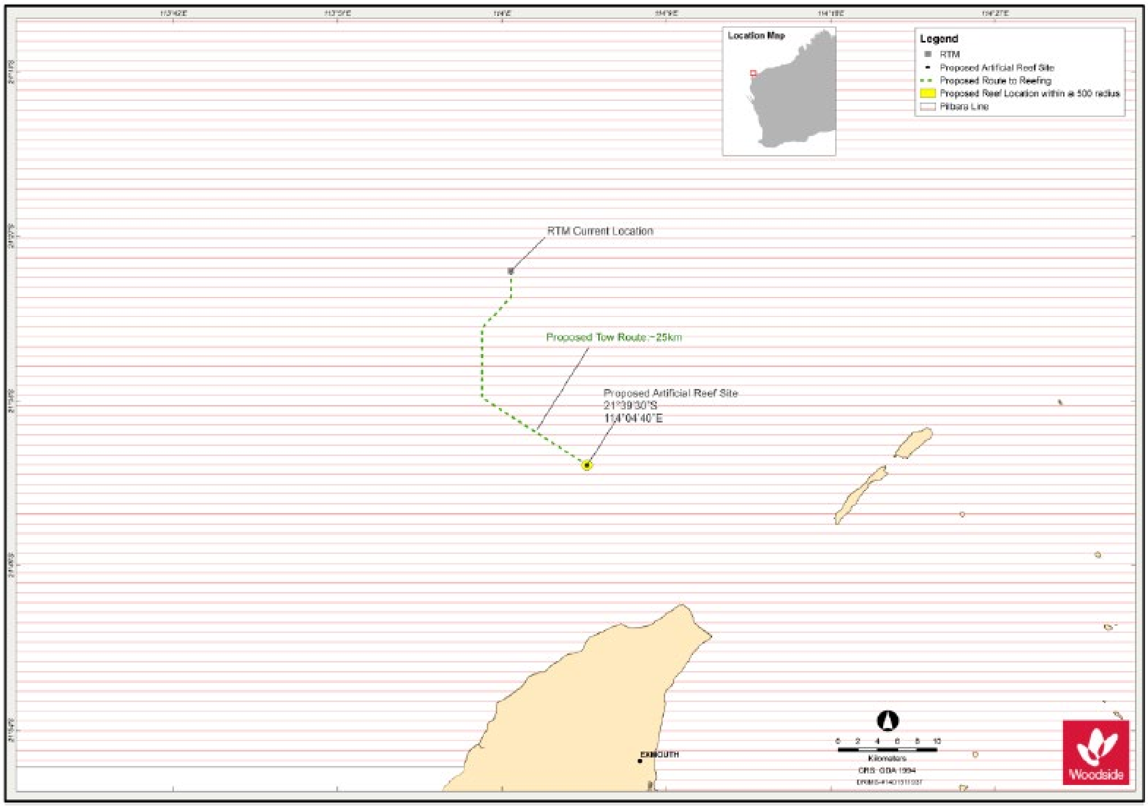
Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

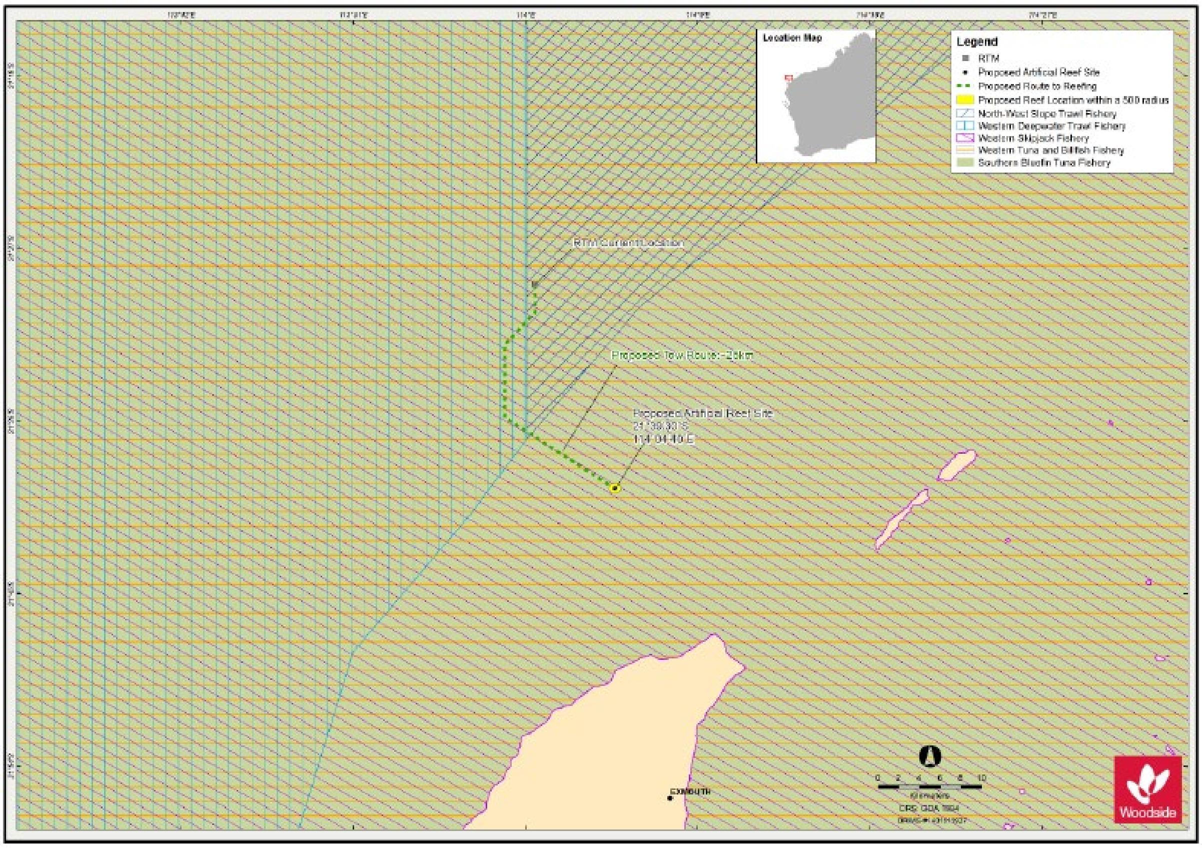
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.
Please provide your views by **24 July 2020.**

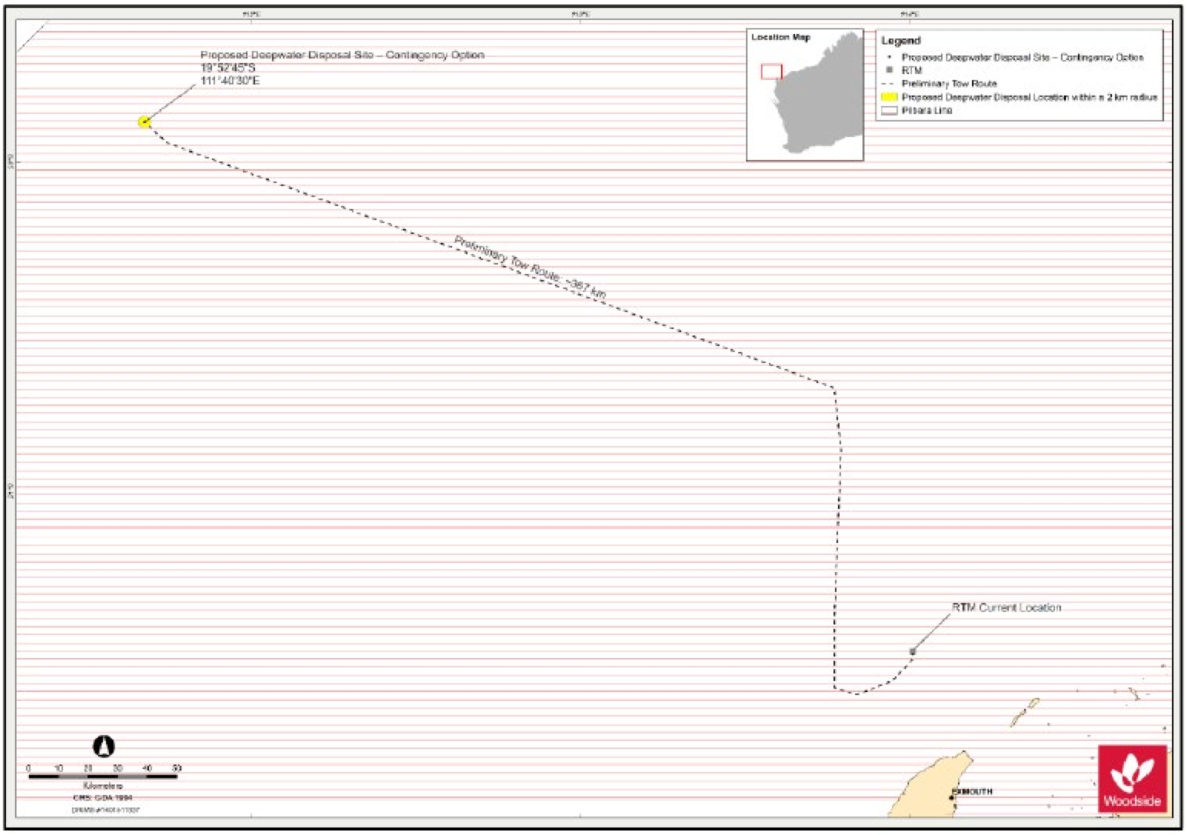
Regards

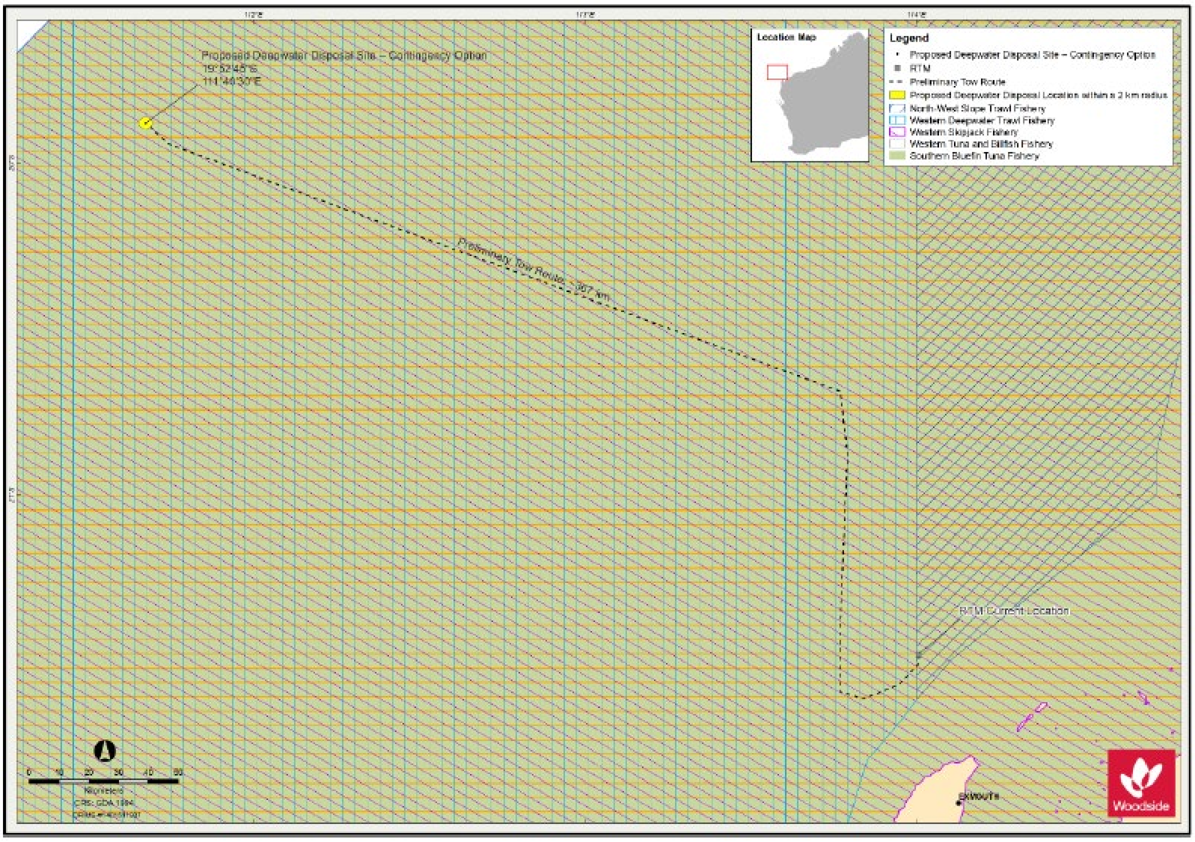
[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.12 State and Commonwealth fisheries maps sent to DPIRD, WAFIC, PPA, DAWR, AFMA, Commonwealth Fisheries Association – 2 July 2020. And Fisheries Licence Holders – 7 July 2020.




Location Map
Legend
RTM
Proposed Artifical Reef Site
Proposed Route to Reefing
Proposed Reef Location within a 500 radius
North-West Slope Trawl Fishery
Western Deepwater Trawl Fishery
Western Skipjack Fishery
Western Tuna and Billfish Fishery
Southern Bluefin Tuna Fishery
RTM Current Location
Proposed Tow Route: ~2km
Proposed Artificial Reef Site
EXMOUTH
Kilometers
CRS: GDA 1994
Woodside


Location Map
Legend
Proposed Deepwater Disposal Site – Contingency Option
RTM
Preliminary Tow Route
Proposed Deepwater Disposal Location within a 2 km radius
Pilbara Line
Proposed Deepwater Disposal Site – Contingency Option
19°52'45"S
111°40'30"E
Preliminary Tow Route: ~367 km
RTM Current Location
EXMOUTH
0 10 20 30 40 50
Kilometers
CRS: GDA 1994
Woodside



2.13 Email sent to DoD – 2 July 2020

Dear Department of Defence

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A mapping showing the defence area is also attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
If you have any issues or concerns with these activities, any other issues relevant to this location then please respond to Woodside at:

feedback@woodside.com.au or +61 438 173 562

Your feedback and our response will be included in our Environment Plan which will be submitted to submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) for acceptance in accordance with the Petroleum (Submerged Lands) (Environment) Regulations 2012 (WA) and the Petroleum Pipelines (Environment) Regulations 2012 (WA).

Please provide your views by 24 July 2020.

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.14 Additional email sent to DoD – 2 July 2020

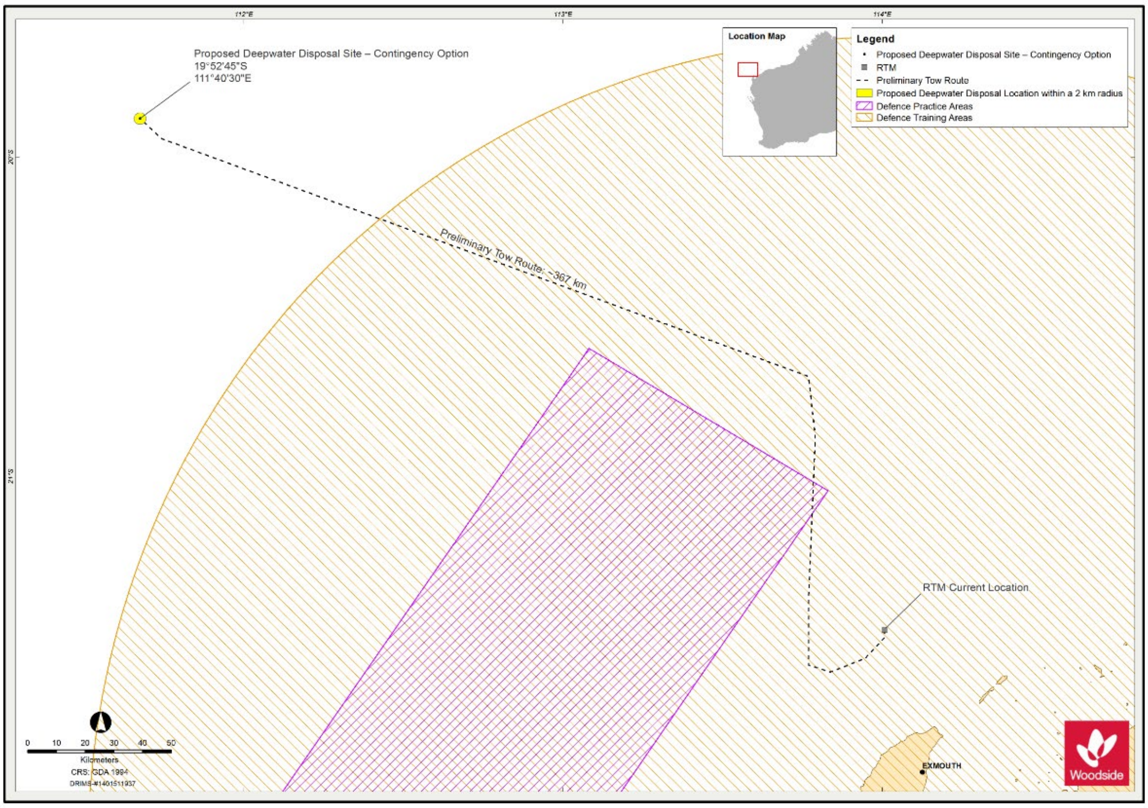
Dear Department of Defence

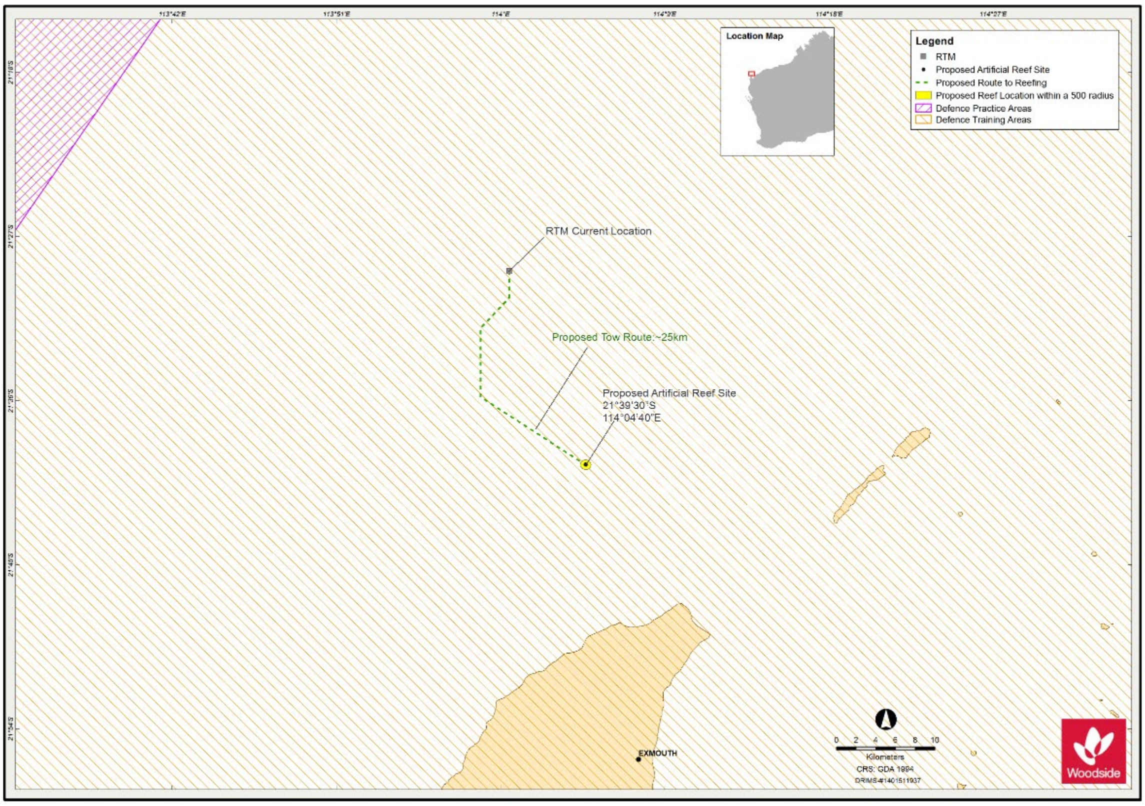
Further to my email below please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) (not DMIRS as stated below) for acceptance in 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 24 July 2020.
Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.15 Defence map sent to DoD – 2 July 2020




Location Map
Legend
RTM
Proposed Artificial Reef Site
Proposed Route to Reefing
Proposed Reef Location within a 500 radius
Defence Practice Areas
Defence Training Areas
RTM Current Location
Proposed Tow Route:~25km
Proposed Artificial Reef Site
21°39'30"S
114°04'40"E
EXMOUTH
Kilometers
CRS: GDA 1994
Woodside

2.16 Email sent to titleholders – BHP, Chevron, KUFPEC, Santos and Shell – 2 July 2020

Dear Titleholder

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A Titles map is also attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

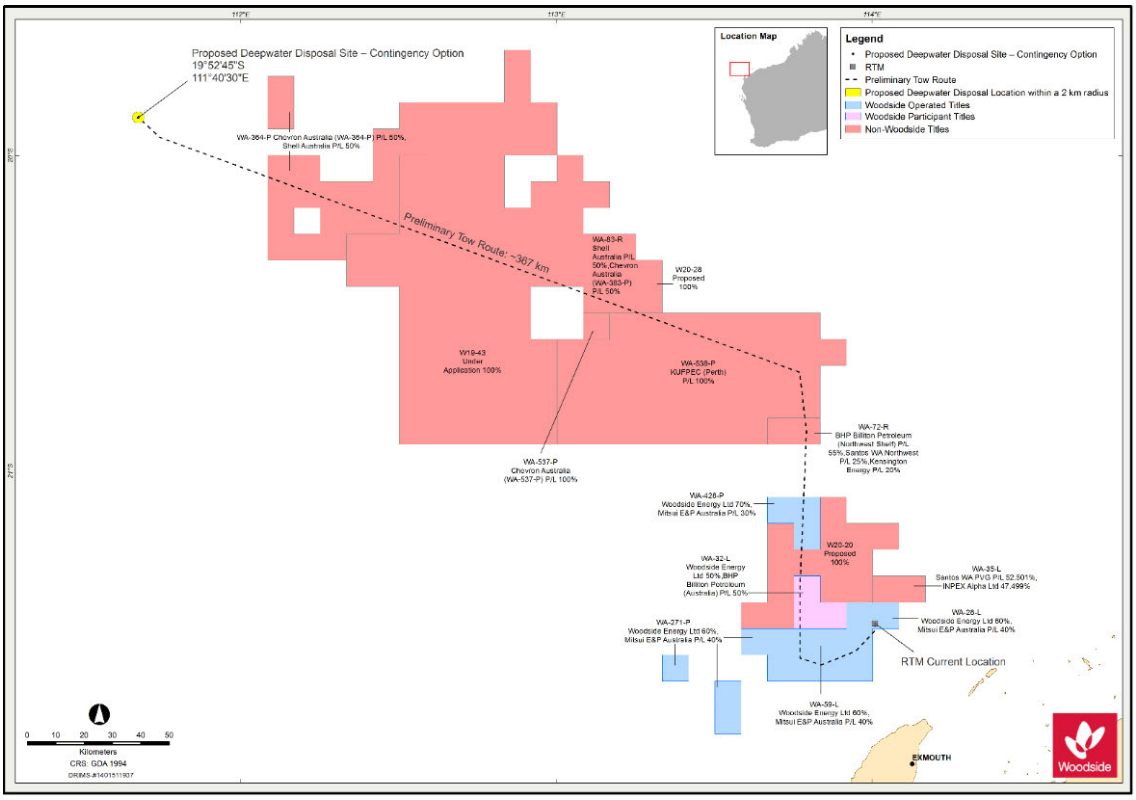
Feedback:
Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

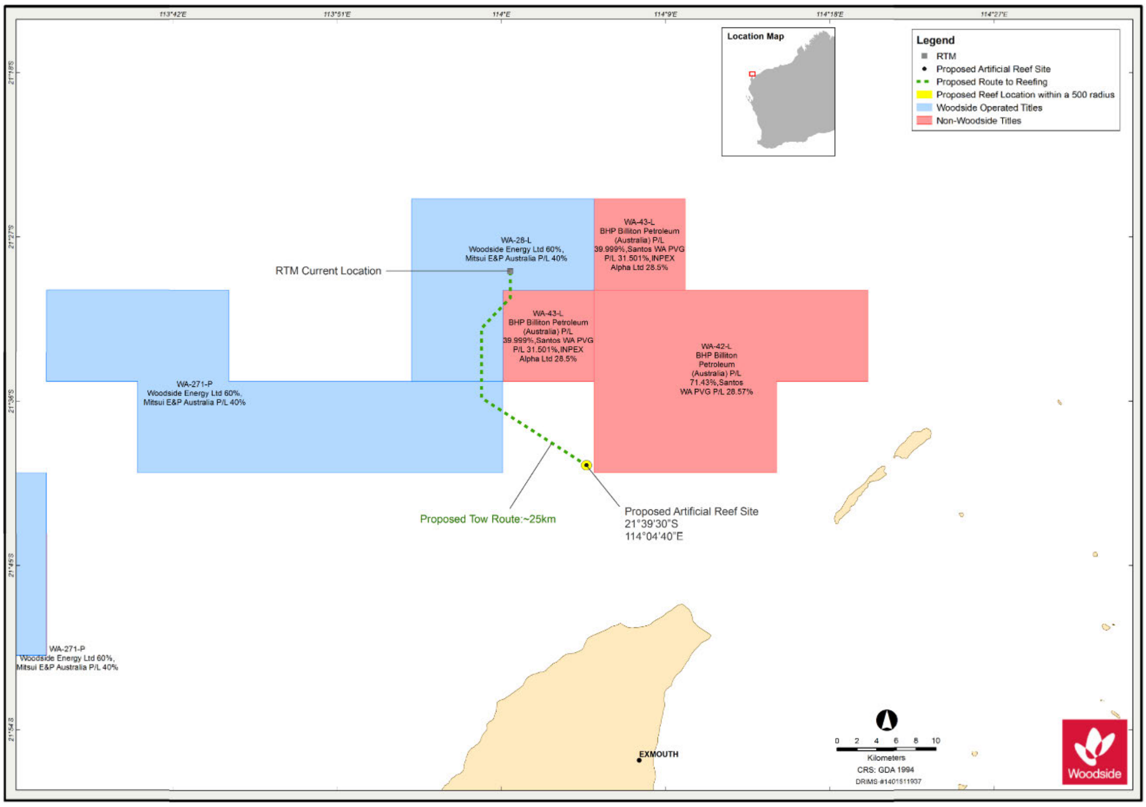
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.17 Titles map sent to titleholders – 2 July 2020





2.18 Presentation to the Exmouth Community Reference Group – 12 March 2020

ENVIRONMENT PLAN

Nganhurra Operations Cessation Environment Plan

+ Preparing for the future decommissioning of infrastructure associated with the Nganhurra Floating Production Storage and Offloading (FPSO) facility.

Update

+ Seeking approval under the Environment Plan and Artificial Reef Application to convert the Riser Turret Mooring (RTM) into an Integrated Artificial Reef.
+ Two baseline surveys have been completed to identify a suitable location off the North West Cape.
+ Consultation with the community will occur as part of the Artificial Reef Application.
+ Removal of the RTM from its current location between Q4 2020 – Q1 2021.

Future Enfield Environment Plans

+ Well intervention activities in preparation for plug and abandonment may commence from 2021, a 500 m zone would be in place around the vessel
+ Commence stakeholder engagement in regards to Enfield subsea infrastructure decommissioning around the second half of 2020

Woodside

Experience the Energy | 12 March 2020 5

2.19 Email sent to Exmouth Community Reference Group – 2 July 2020

Dear Exmouth Community Reference Group

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E	• 350 km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.20 Email sent to Exmouth Game Fishing Club – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of shipping lanes is attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E	• 350 km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E

Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.21 Email sent to Exmouth Chamber of Commerce and Industry – 2 July 2020

Dear [redacted] / Exmouth Chamber of Commerce and Industry

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of shipping lanes is attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.22 Email sent to the Shire of Exmouth – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of shipping lanes is attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E	• 350 km North West of Exmouth, Western Australia • 21o 39’ 30” S, 114o 04’ 40” E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:

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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.23 Email sent to AMSA (marine safety) – 2 July 2020

Dear AMSA

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia	• 350 km North West of Exmouth, Western Australia

	• 21o 39' 30" S, 114o 04' 40" E	• 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.24 Email sent to AMSA (marine pollution) – 6 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.25 Email sent to AHO – 2 July 2020

Dear AHO

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of shipping lanes is attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
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Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:

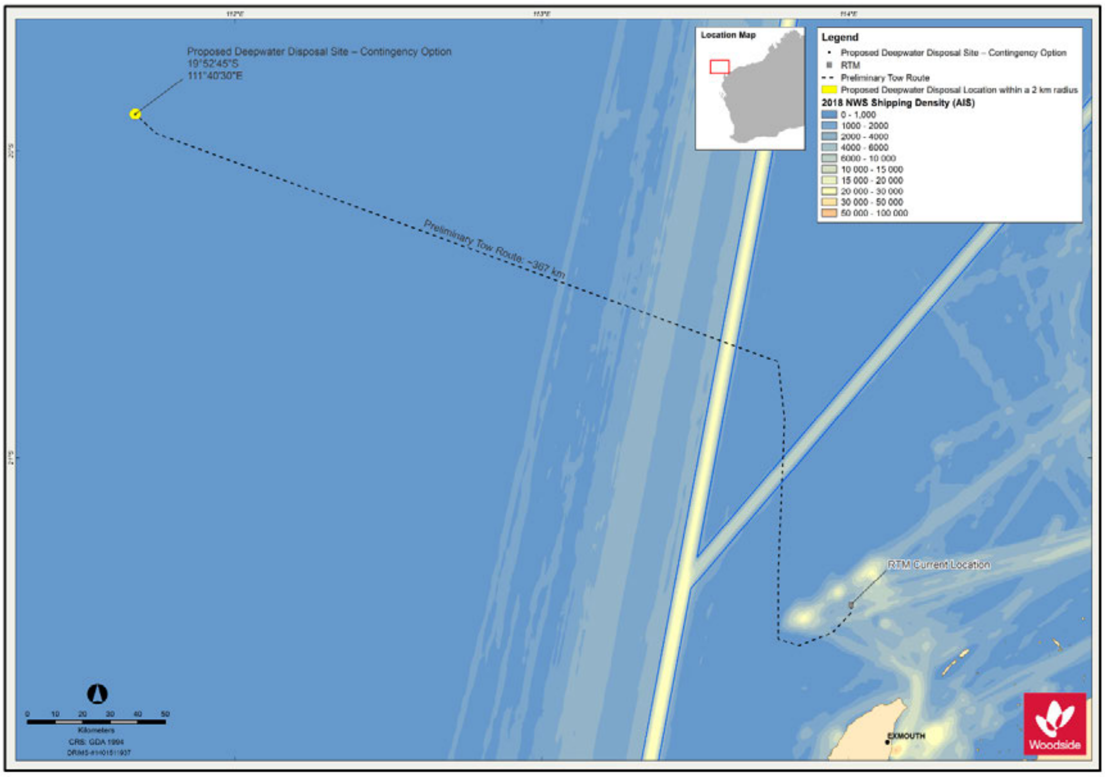
Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

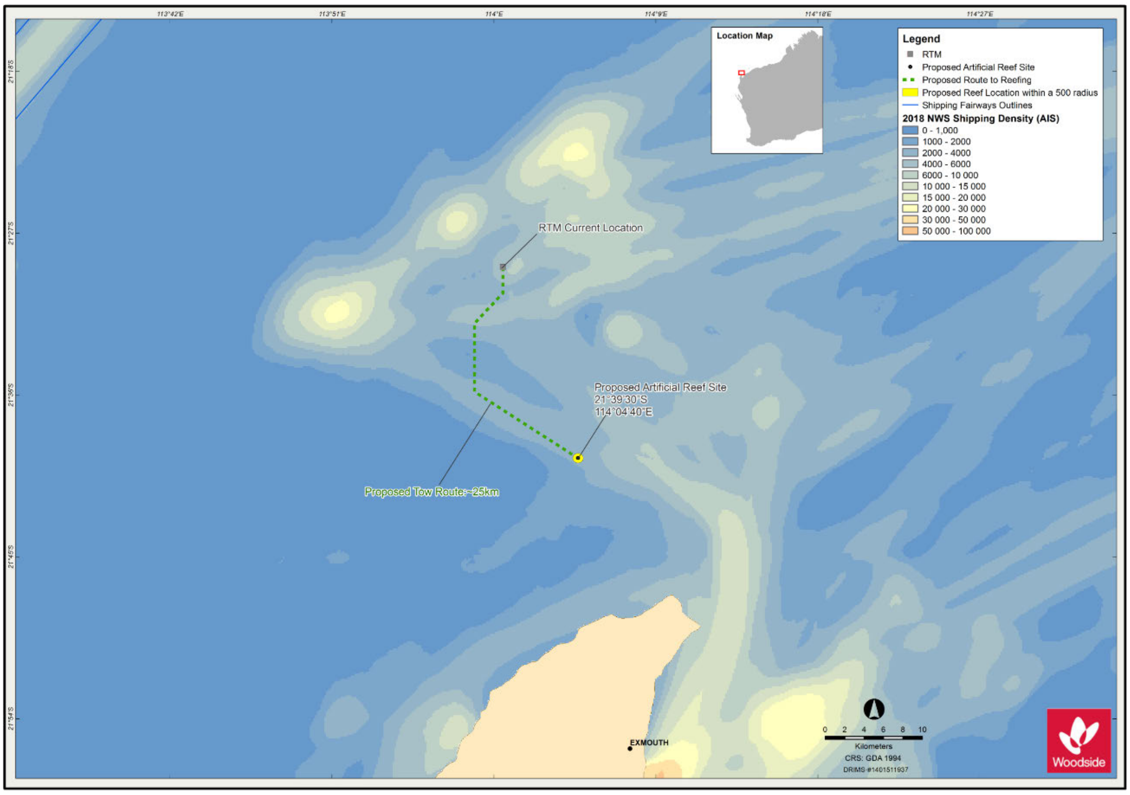
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.26 Shipping Lanes map sent to AMSA and AHO – 2 July 2020





2.27 Email sent to DNP – 2 July 2020

Dear Director of National Parks

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

We note Australian Government Guidance on consultation activities with respect to the proposed activities and confirm that the proposed activities are outside the boundaries of a proclaimed Australian Marine Parks, with the activities taking place approximately greater than 300 m north of the Commonwealth boundary of the Ningaloo Marine Park (at the closest point) and approximately 15 km north of the Gascoyne Commonwealth Marine Reserve. No activities will occur within any marine park.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
If you have any issues or concerns with these activities, any other issues relevant to this location then please respond to Woodside at:

feedback@woodside.com.au or +61 438 173 562

Your feedback and our response will be included in our Environment Plan which will be submitted to submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) for acceptance in accordance with the Petroleum (Submerged Lands) (Environment) Regulations 2012 (WA) and the Petroleum Pipelines (Environment) Regulations 2012 (WA).

Please provide your views by **24 July 2020.**
Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.28 Additional email sent to DNP – 2 July 2020

Dear Director of National Parks

Further to my email below 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) (not DMIRS as stated below) 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 24 July 2020.

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.29 Email sent to Ningaloo Coast World Heritage Advisory Committee – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.

	Integrated Artificial Reef	Contingency Deepwater Disposal
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.30 Email sent to Cape Conservation Group – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.31 Email sent to Project Ningaloo – 2 July 2020

Dear [redacted]

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website. A map of shipping lanes is attached.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
	Integrated Artificial Reef	**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during	• A temporary 500 m operational exclusion zone will apply during

	tow and placement No exclusion zones once on the seafloor	tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.32 Email sent to Nganhurra Thanardi Garrbu Aboriginal Corporation – 6 July 2020

Dear Stakeholder

Please find attached and below additional consultation information on the re-purposing of the Riser Turret Mooring (RTM) which will be included in the Nganhurra Cessations of Operation Environment Plan Revision. Previous information on the activities proposed within the Environment Plan can be found here.

After a comprehensive evaluation of options, Woodside is proposing to re-purpose the RTM as an integrated deep water artificial reef at 150 m water depth, around 16 km off the North West Cape. Recfishwest will apply for a permit for the integrated artificial reef which will include the RTM and new purpose-built reef tower modules.

Woodside will concurrently seek approval from the Department of Agriculture, Water and the Environment to dispose of the RTM at a deep water (2,000 m) location, around 350 km off the North West Cape should the artificial reef not be approved.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity:

Summary:	• Towing and placement of the Riser Turret Mooring as Integrated Artificial Reef. • A Deepwater Disposal option is planned as a contingency should the artificial reef option not be approved.	
Integrated Artificial Reef		**Contingency Deepwater Disposal**
Location:	• ~16km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E	• 350 km North West of Exmouth, Western Australia • 21o 39' 30" S, 114o 04' 40" E
Schedule:	• Between December 2020 and March 2021	• Between December 2020 and March 2021
Duration:	• 15 – 25 Days	• 15 – 25 Days
Approximate water depth:	• ~ 150 m	• ~ 2000 m
Exclusion/cautionary zone:	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor	• A temporary 500 m operational exclusion zone will apply during tow and placement No exclusion zones once on the seafloor
Vessels:	• Anchor Handling Tugs • Installation Vessel	• Anchor Handling Tugs • Installation Vessel

Feedback:
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.
Please provide your views by **24 July 2020.**

Regards

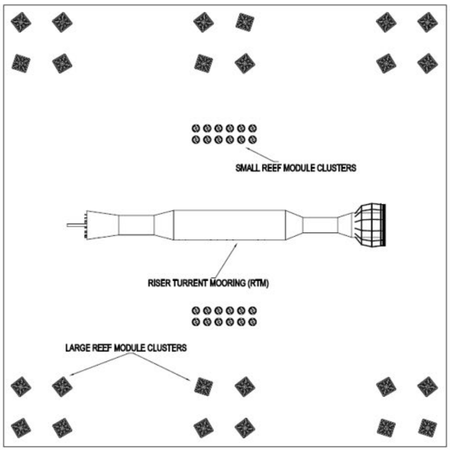
[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.33 Presentation to the Exmouth Community Reference Group – 7 September 2020

ENVIRONMENT PLAN

Nganhurra Operations Cessation Environment Plan Revision

+ We have revised and re-submitted a new Environment Plan to NOPSEMA.
+ Additional consultation has been completed on the proposal to re-purpose the Riser Turret Mooring (RTM) as part of an integrated artificial reef.
+ Appreciate the quality of local stakeholder feedback, which has informed the artificial reef concept.
+ The reef is proposed to be located around 16 km north west of Exmouth.
+ Recfishwest has applied for a permit for the reef which will include 48 purpose built reef modules.
+ Risers will be removed from the RTM.



Information Sheet: https://files.woodside/docs/default-source/current-consultation-activities/australian-activties/nganhurra-operations-cessation-environment-plan---additional-information-july-2020.pdf?sfvrsn=d4180976_1

Experience the Energy | 1 September 2020 5

2.34 Additional email to AFMA – 17 July 2020

Dear AFMA

I'm just following up on email below to see if you'd like to discuss the information below?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.35 Additional email to ECCI – 16 July 2020

Hi [redacted]

I'm just following up on email below to see if you'd like to discuss the information below?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.36 Additional email to Exmouth Shire – 16 July 2020

Hi [redacted]

I'm just following up on email below to see if you'd like to discuss the information below?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.37 Additional email to DNP – 23 July 2020

Dear Director of National Parks

I am following up on my email below to see if you would like to discuss the proposed activity or have any queries?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.38 Additional email to Ningaloo Coast World Heritage Advisory Committee – 16 July 2020

Hi [redacted]

I'm just following up on email below to see if you'd like to further discuss the information below?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.39 Additional email to Cape Conservation Group – 16 July 2020

Hi [redacted]

I'm just following up on email below to see if you'd like to discuss the information below?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

2.40 Additional email to Protect Ningaloo – 16 July 2020

Hi [redacted]

I’m just following up on email below to see if you’d like to discuss the information below?

Regards

[redacted]
Senior Corporate Affairs Adviser | Operations
Woodside Energy Ltd

APPENDIX G: DEPARTMENT OF ABORIGINAL AFFAIRS (DAA) HERITAGE INQUIRY SYSTEM RESULTS

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

2 Registered Aboriginal Sites in Coordinates - Area (SEMBA Coordinates.xlsx) - 110.35940882°E, 25.5774728493999°S (GDA94) : 110.216962677°E, 25.3789443324°S (GDA94) : 110.056807358°E, 25.1943660031999°S (GDA94) : 109.884643596999°E, 25.0210161779°S (GDA94) : 109.703786339999°E, 24.8567158761999°S (GDA94) : 109.517326901°E, 24.6987808270999°S (GDA94) : 109.327533413°E, 24.5448503072°S (GDA94) : 109.137826137999°E, 24.3908249264999°S (GDA94) : 108.957267132°E, 24.2263782676999°S (GDA94) : 108.79565418°E, 24.0435520212°S (GDA94) : 108.669420729°E, 23.834706214°S (GDA94) : 108.574184282°E, 23.6099762316999°S (GDA94) : 108.507731026°E, 23.3750189436°S (GDA94) : 108.466848654°E, 23.1343171474999°S (GDA94) : 108.457947027°E, 22.8904128904°S (GDA94) : 108.485827929°E, 22.6478534423999°S (GDA94) : 108.530797664999°E, 22.4076669501999°S (GDA94) : 108.583398793°E, 22.1690511247999°S (GDA94) : 108.658513716°E, 21.9366436918°S (GDA94) : 108.739852173°E, 21.7062029372°S (GDA94) : 108.811668856°E, 21.47269906°S (GDA94) : 108.863626221°E, 21.2339621674°S (GDA94) : 108.906852803°E, 20.9934885129°S (GDA94) : 108.946414223999°E, 20.7523375644999°S (GDA94) : 108.985975646°E, 20.511186616°S (GDA94) : 109.028214554°E, 20.2705121937°S (GDA94) : 109.079713721999°E, 20.0316688797°S (GDA94) : 109.145596473°E, 19.7964136585999°S (GDA94) : 109.233275863°E, 19.5683567835999°S (GDA94) : 109.326543138999°E, 19.3424804872°S (GDA94) : 109.406297393°E, 19.1116266074°S (GDA94) : 109.467525047°E, 18.8751520659°S (GDA94) : 109.52318782°E, 18.6372013531999°S (GDA94) : 109.581771096°E, 18.39998316°S (GDA94) : 109.654533803°E, 18.1668096731°S (GDA94) : 109.752103739°E, 17.9429283929°S (GDA94) : 109.866438978°E, 17.7269878709999°S (GDA94) : 109.985356073999°E, 17.5134987371999°S (GDA94) : 110.10375397°E, 17.299738854°S (GDA94) : 110.206333624°E, 17.078077874°S (GDA94) : 110.289647358°E, 16.8485231718999°S (GDA94) : 110.352749215°E, 16.6125906338999°S (GDA94) : 110.394544135999°E, 16.3719403481°S (GDA94) : 110.406346973°E, 16.1280591487°S (GDA94) : 110.392346945°E, 15.8842092839°S (GDA94) : 110.372821938°E, 15.6406496703°S (GDA94) : 110.383387067°E, 15.3972038964°S (GDA94) : 110.422541335°E, 15.290024676°S (GDA94) : 110.510304076°E, 15.1874880853°S (GDA94) : 110.786433426°E, 15.0407851125°S (GDA94) : 111.187386059°E, 14.9384963422°S (GDA94) : 111.428999597°E, 14.902346514°S (GDA94) : 111.672320778°E, 14.8805646377999°S (GDA94) : 111.916531899°E, 14.8746637874999°S (GDA94) : 112.160336786°E, 14.8897474885999°S (GDA94) : 112.401433514999°E, 14.9287282277°S (GDA94) : 112.638181845°E, 14.9891045526°S (GDA94) : 112.87140979°E, 15.0619523949°S (GDA94) : 113.101961437°E, 15.142922991°S (GDA94) : 113.330432341°E, 15.2296069679°S (GDA94) : 113.558213264°E, 15.3181210189999°S (GDA94) : 113.785994187°E, 15.40663507°S (GDA94) : 114.01377511°E, 15.4951491211°S (GDA94) : 114.242186790999°E, 15.5819651262°S (GDA94) : 114.472515259°E, 15.6636210076°S (GDA94) : 114.704385372°E, 15.7406471549°S (GDA94) : 114.939407536999°E, 15.8074602575°S (GDA94) : 115.177964829°E, 15.8601733439°S (GDA94) : 115.419022510999°E, 15.8998692925°S (GDA94) : 115.661536016°E, 15.9299007878999°S (GDA94) : 115.904136167999°E, 15.9592955601999°S (GDA94) : 116.146456717°E, 15.9908438464°S (GDA94) : 116.387474428°E, 16.0310167236999°S (GDA94) : 116.623833174°E, 16.0925589000999°S (GDA94) : 116.845737087°E, 16.1935437773°S (GDA94) : 117.027764827°E, 16.3554338573°S (GDA94) : 117.170426886°E, 16.5533354674°S (GDA94) : 117.287182618°E, 16.767765908°S (GDA94) : 117.385893912°E, 16.9912096583999°S (GDA94) : 117.470939188°E, 17.2202659577°S (GDA94) : 117.542489735°E, 17.4538921694°S (GDA94) : 117.599514523°E, 17.6914270645°S (GDA94) : 117.636840714°E, 17.9327130004°S (GDA94) : 117.644319928°E, 18.1765209524°S (GDA94) : 117.604243861°E, 18.4165008055999°S (GDA94) : 117.506347410999°E, 18.6396149384999°S (GDA94) : 117.366829948°E, 18.8397734403999°S (GDA94) : 117.203578069°E, 19.0214078073°S (GDA94) : 117.027841878°E, 19.1911484361999°S (GDA94) : 116.844165462°E, 19.3522814678999°S (GDA94) : 116.655506704999°E, 19.5075981749°S (GDA94) : 116.464885413999°E, 19.6605112529999°S (GDA94) : 116.274264122999°E, 19.813424331°S (GDA94) : 116.083642832°E, 19.9663374090999°S (GDA94) : 115.897614627°E, 20.1247023847°S (GDA94) : 115.72967619°E, 20.3019752506°S (GDA94) : 115.582252951°E, 20.4965757563999°S (GDA94) : 115.452852706°E, 20.7038463216999°S (GDA94) : 115.332959805°E, 20.9167889856999°S (GDA94) : 115.206518397°E, 21.1258230619999°S (GDA94) : 115.053091892°E, 21.3157238275°S (GDA94) : 114.902279754°E, 21.4662341575999°S (GDA94) : 114.778612186999°E, 21.5659182284°S (GDA94) : 114.60973156°E, 21.6509579071999°S (GDA94) : 114.159537537°E, 21.7661238198°S (GDA94) : 114.052586069°E, 21.8262440208999°S (GDA94) : 113.901232541°E, 21.9700878668°S (GDA94) : 113.747118837°E, 22.2047358388°S (GDA94) : 113.673175708°E, 22.3895426033999°S (GDA94) : 113.648429312999°E, 22.5551530894°S (GDA94) : 113.674822432°E, 22.8895111695°S (GDA94) : 113.676982845°E, 23.1661986756999°S (GDA94) : 113.64192325°E, 23.3876757218°S (GDA94) : 113.528065075°E, 23.7020599690999°S (GDA94) : 113.431052452°E, 23.926330215°S (GDA94) : 113.324621388°E, 24.1463104749°S (GDA94) : 113.218190324999°E, 24.3662907347°S (GDA94) : 113.105156797°E, 24.5829415382°S (GDA94) : 112.99155127°E, 24.799303897°S (GDA94) : 112.873244795°E, 25.0130522105°S (GDA94) : 112.733689236°E, 25.213486833°S (GDA94) : 112.582234295°E, 25.4051870412°S (GDA94) : 112.420861134°E, 25.5886119211°S (GDA94) : 112.253034378°E, 25.7662437482°S (GDA94) : 112.090279636999°E, 25.9485331121°S (GDA94) : 111.912184537°E, 26.1154974807999°S (GDA94) : 111.711108135999°E, 26.2534107534999°S (GDA94) : 111.48551854°E, 26.3456748494°S (GDA94) : 111.24453607°E, 26.3818459286999°S (GDA94) : 111.00321112°E, 26.349612873°S (GDA94) : 110.780964436999°E, 26.2505546961°S (GDA94) : 110.57179451°E, 26.0302546879°S (GDA94)

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

Copyright

Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.

Status:

- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972.*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972.*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972.*

Access and Restrictions:

- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact heritageenquiries@dplh.wa.gov.au.
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least $4km^2$) 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.

Basemap Copyright

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
873	MONTEBELLO IS: NOALA CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, BP Dating: 27,220 +/- 640	*Registered Knowledge Holder names available from DAA	348188mE 7741053mN Zone 50 [Reliable]	P07287
926	MONTEBELLO IS: HAYNES CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, Arch Deposit	*Registered Knowledge Holder names available from DAA	348289mE 7741005mN Zone 50 [Reliable]	P07286

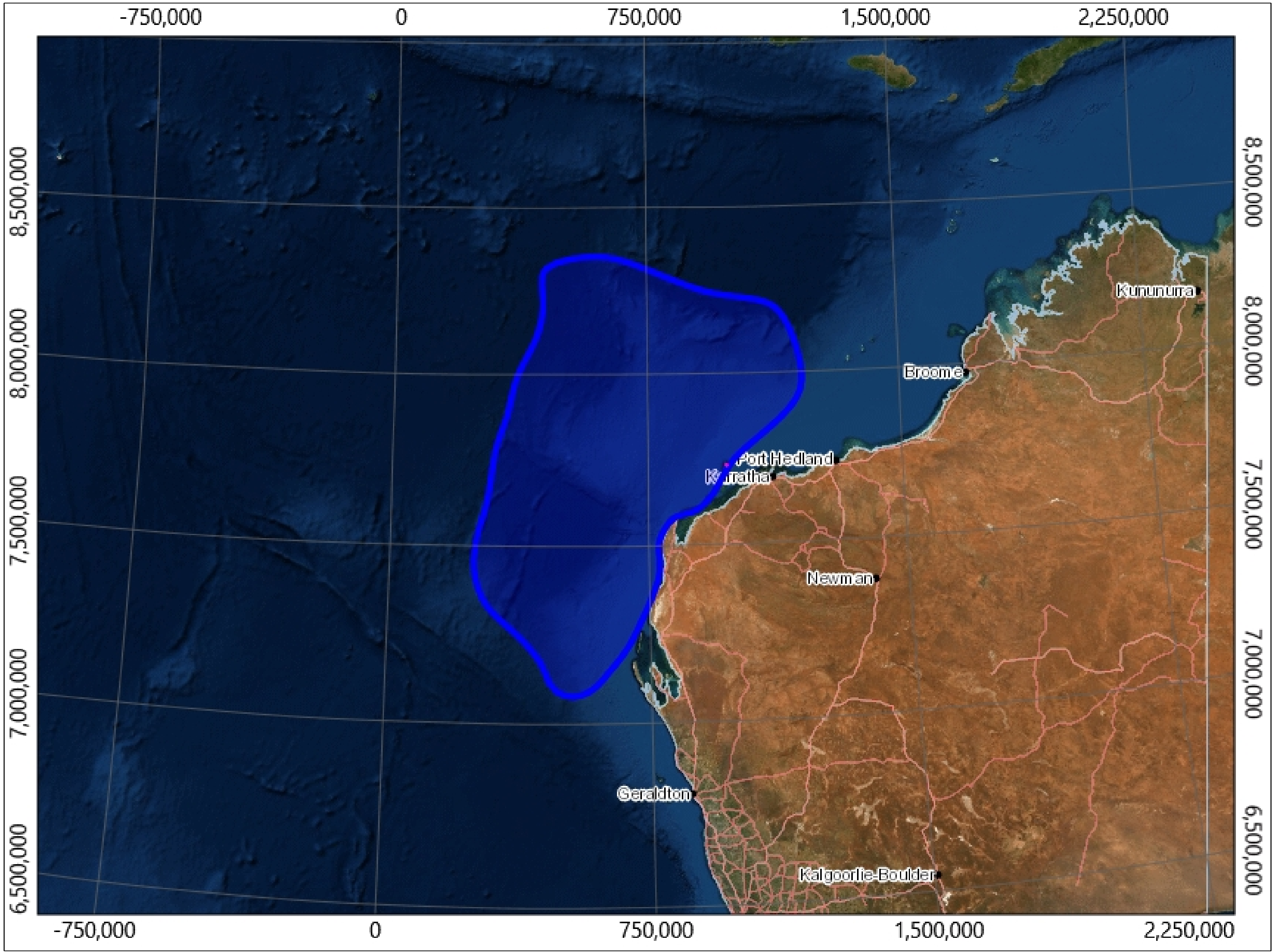
Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

For further important information on using this information please see the Department of Planning, Lands and Heritage's Disclaimer statement at https://www.dplh.wa.gov.au/about-this-website



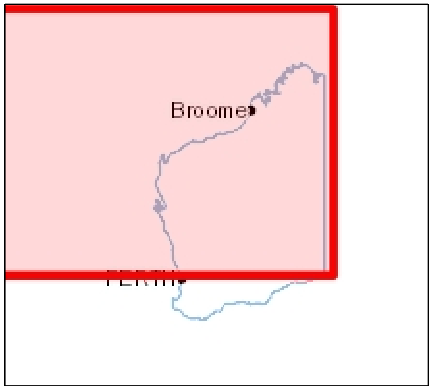
Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

597.02 kilometres

Map Scale 1 : 18,090,000

MGA Zone 49 (GDA94)



APPENDIX D – TRACKING BUOY DEPLOYMENT INSTRUCTIONS

(Insert Link when printing)

APPENDIX H: FIRST STRIKE PLAN

Nganhurra Cessation of Operations – Oil Pollution First Strike Plan

Security and Emergency Management
Hydrocarbon Spill Preparedness Unit

September 2020

Revision: 8b

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NGANHURRA CESSATION OF OPERATIONS OIL POLLUTION FIRST STRIKE PLAN

This plan supersedes the Nganhurra Floating Production Storage and Offloading (FPSO) Facility Oil Pollution First Strike Plan.

The Nganhurra FPSO is no longer on location and the Asset (riser turret mooring (RTM) and subsea hardware) has ceased operations. Refer to the Nganhurra Safety Case for further information.

Spill type	Level	Control Agency	Incident Controller
SPILL FROM FACILITY INCLUDING SUBSEA INFRASTRUCTURE *(Note: Pipe laying and accommodation vessels are considered a "FACILITY" under Australian Regs).*	LEVEL 1	WOODSIDE	Person In Charge (PIC) with support from Onshore Team Leader (OTL)
	LEVEL 2 and 3	WOODSIDE	CICC DUTY MANAGER
SPILL FROM FACILITY ENTERING STATE WATERS	LEVEL 1	WOODSIDE	CICC DUTY MANAGER
	LEVEL 2 and 3	DoT	DoT IC
SPILL FROM VESSEL *(Note: Shipboard Oil Pollution Emergency Plan (SOPEP) should be implemented in conjunction with this document)*	LEVEL 1	AMSA	VESSEL MASTER (with response assistance from Woodside)
	LEVEL 2 and 3	AMSA	AMSA (with response assistance from Woodside)

Guidance to Oil Spill Incident Levels

The most significant characteristic of the below guidance should be considered when determining level or escalation potential.

Characteristic	Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
General Description	Generally able to be resolved within 24-48 hours.	Generally response required beyond 48 hours.	Response may extend beyond weeks.
Woodside Emergency Management (EM)/ Crisis Management Team (CMT) Activation	Onsite Incident Controller (IC) activated. Use of ICC support may be required.	Additional support required from Corporate Incident Coordination Centre (CICC) Duty Manager (DM).	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).

If the spill impacts State waters/shorelines and is a Level 1, Woodside will remain the Controlling Agency. If the spill is a Level 2/3 then DoT will become the Control Agency for the response in State waters/shorelines only. DoT will appoint an Incident Controller and form a separate Incident Management Team to manage the State waters/shorelines response only. The coordination structure for a concurrent hydrocarbon spill in both Commonwealth and State waters/shorelines is shown in APPENDIX E – Coordination Structure for a Concurrent Hydrocarbon Spill in Both Commonwealth And State Waters/Shorelines.

Initially Woodside will be required to make available an appropriate number of suitably qualified persons to work in the DoT IMT (see APPENDIX G – Woodside liason officer resources to DoT). DoT's role as the Controlling Agency for Level 2 and 3 spills in State waters/shorelines does not negate the requirement for Woodside to have appropriate plans and resources in place to adequately respond to a Marine Hydrocarbon Spill incident in State waters/shorelines or to commence the initial response actions to a spill prior to DoT establishing incident control in line with DoT Offshore Petroleum Industry Guidance Note - Marine Oil Pollution: Response and Consultation Arrangements (July 2020):

https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf

Response Process Overview

Use the below to determine actions required and which parts of this plan are relevant to the incident.		
For guidance on credible scenarios and hydrocarbon characteristics, refer to APPENDIX A – credible spill scenarios and Hydrocarbon Information		
ALL INCIDENTS	Notify the Woodside Communication Centre (WCC) on: [redacted] or sat phone: [redacted]	
	Incident Controller or delegate to make relevant notifications in Table 1-1 of this document.	
LEVEL 1	**FACILITY INCIDENT**	**VESSEL INCIDENT**
	Coordinate pre-identified tactics in Table 2-1 of this document. Remember to download each Operational Plan.	**Upon agreement with AMSA:** Coordinate pre-identified tactics in Table 2-1 of this document. Remember to download each Operational Plan.
	If the spill escalates such that the site cannot manage the incident, inform the WCC on: [redacted] or sat phone [redacted] and escalate to a Level 2/3 incident.	
LEVEL 2/3	**FACILITY INCIDENT**	**VESSEL INCIDENT**
	Handover control to CICC for facility spill including from subsea infrastructure. **OR** Handover control to DoT for facility spill which has entered State waters.	Stand up CICC to assist AMSA.
	Undertake quick revalidation of the recommended strategies on Table 3-1 taking into consideration seasonal sensitivities and current situational awareness. Undertake validated strategies.	**If requested by AMSA:** Undertake quick revalidation of the recommended strategies on Table 3-1 taking into consideration seasonal sensitivities and current situational awareness. Undertake validated strategies.
	Create an Incident Action Plan (IAP) for all ongoing operational periods. **The content of the IAP should reflect the selected response strategies based on current situational awareness.** For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see Nganhurra Cessation of Operations Pre-operational NEBA.	**If requested by AMSA:** Create an IAP for all ongoing operational periods. **The content of the IAP should reflect the selected response strategies based on current situational awareness.** For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see Nganhurra Cessation of Operations Pre-operational NEBA.

1. NOTIFICATIONS (ALL LEVELS)

The Incident Controller or delegate must ensure the below notifications Table 1-1 are completed within the designated timeframes.

For other environmental notifications required refer to the *Nganhurra Cessation of 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 Woodside (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 Representative (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 NOPTA and DMIRS).	APPENDIX B – Form 1	
Within 3 days	OIM or WSR				Provide a written NOPSEMA Incident Report Form as soon as practicable (no later than 3 days after notification) (cc to NOPTA and DMIRS) NOPSEMA: submissions@nopsema.gov.au	APPENDIX B – Form 2	

[1] Notification to NOPSEMA must be from a Woodside Representative.

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					NOPTA: resources@nopta.gov.au DMIRS: petreps@dmirs.wa.gov.au		
As soon as practicable	OIM or WSR	Woodside	Hydrocarbon Spill Preparedness Manager	[redacted]	Verbally notify Hydrocarbon Spill Preparedness (HSP) Manager of event and estimated volume and hydrocarbon type.	Verbal	
As soon as practicable	CICC DM or Delegate	Woodside	Environment Duty Manager	As per roster	Verbally notify Duty Environment of event and seek advice on relevant performance tandards from EP.	Verbal	
As soon as practicable	CICC DM or Delegate	Department of Agriculture, Water and the Environment (Director of National Parks)	Marine Park Compliance Duty Officer	[redacted]	The Marine Park Compliance Duty Officer is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken. The notification should include: • titleholder details • time and location of the incident • proposed response arrangements and locations as per the OPEP contact details for the response coordinator.	Verbal	
Additional notifications to be made ONLY if spill is from a vessel							
Without delay as per protection of the Sea Act, part II, section 11(1)	Vessel Master	Australian Maritime Safety Authority (AMSA)	Response Coordination Centre (RCC)	[redacted] or	Verbally notify AMSA RCC of the hydrocarbon spill. Follow up with a written Marine Pollution Report (POLREP) as	APPENDIX B – Form 3	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
				[redacted]	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 AMOSC that a spill has occurred and follow-up with an email from the IC/CICC DM, CMT Leader or Oil Spill Preparedness Manager to formally activate AMOSC. Determine what resources are required consistent with the AMOSPlan and detail in a Service Contract that will be sent to Woodside from AMOSC upon activation.	APPENDIX B – Form 4	
As soon as practicable	CICC DM or Delegate	Oil Spill Response Limited (OSRL)	OSRL Duty Manager	[redacted]	Contact OSRL Duty Manager and request assistance from technical advisor in Perth. Send the notification form to OSRL as soon as practicable. For mobilisation of resources, send the Mobilisation Form to OSRL as soon as practicable.	Notification: APPENDIX B – Form 6a Mobilisation: APPENDIX B – Form 6b	
As soon as practicable or if spill is likely to extend into WA State waters.	CICC DM or Delegate	WA Department of Transport	DOT Duty Manager	[redacted]	Marine Duty Manager to verbally notify DoT that a spill has occurred and request use of equipment stored in the Exmouth supply shed at Harold E Holt. Follow up with a written POLREP as soon as practicable following verbal notification.	APPENDIX B – Form 5	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					Additionally DoT to be notified if spill is likely to extend into WA State waters. Request DoT to provide Liaison to WEL IMT.		
As soon as practicable if there is potential for oiled wildlife or the spill is expected to contact land or waters managed by WA Department of Biodiversity, Conservation and Attractions	CICC DM or Delegate	WA Department of Biodiversity, Conservation and Attractions (DBCA)	Duty Officer	[redacted]	Phone call notification.	Verbal	
As soon as practicable	CICC DM or Delegate	Marine Spill Response Corporation (MSRC)	MSRC Response Manager	[redacted]	Activate the contract with MSRC (in full) for the provision of up to 30 personnel depending on what skills are required. Please note that provision of these personnel from MSRC are on a best endeavours basis and are not guaranteed.	Verbal	

2. LEVEL 1 RESPONSE

2.1 Mobilisation of Response Techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a ‘Yes’ in Table 2-1. Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 2-1 Operational Plan column.

All response techniques and pre-identified tactics have been identified from the pre-operational NEBA presented in the Nganhurra Cessation of Operations Environment Plan APPENDIX D: Oil Spill Preparedness and Response Mitigation Assessment.

Table 2-1: Level 1 Response Summary

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
Monitor and Evaluate (Operational Monitoring)	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 2 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.						
	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.	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool. Detailed modelling within four hours of APASA receiving information from Woodside.		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	Send Oil Spill Trajectory Modelling (OSTM) form APPENDIX B, Form 7 to RPS APASA response team (email response@apasa.com.au) and call [redacted].	Intelligence			
	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.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan).

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
					Report made available to the IMT within two hours of landing after each sortie.		*Planning to download immediately and follow steps.*
	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up KSAT to provide satellite imagery of the spill (email emergency@ksat.no and call [redacted]	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours. Data received to be uploaded into Woodside Common Operating Picture.		
	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).
	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).
	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 two specialists in SCAT for each of the RPAs with predicted impacts.		Shoreline Assessment (OM05 of The Operational Monitoring Operational Plan).

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 Nganhurra Cessation of Operations Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

Table 3-1: Level 2/3 Response Summary

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
Monitor and Evaluate (Operational Monitoring)	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 2 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.
	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.	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool. Detailed modelling within four hours of APASA receiving information from Woodside.		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	Send Oil Spill Trajectory Modelling (OSTM) form APPENDIX B, Form 7 to RPS APASA response team (email response@apasa.com.au) and call +61 755741112	Intelligence	**DAY 1:** Detailed modelling within 4 hours of APASA receiving information from Woodside.		
	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.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
					Report made available to the IMT within two hours of landing after each sortie.		The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up KSAT to provide satellite imagery of the spill (email emergency@ksat.no and call [redacted]	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours. Data received to be uploaded into Woodside Common Operating Picture.		
	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).
	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.
	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 two specialists in SCAT for each of the RPAs with predicted impacts.		Shoreline Assessment (OM05) of The Operational Monitoring Operational Plan.
Surface Dispersant	No	Potentially	Mobilise Karratha and Exmouth stockpiles.		**DAY 1:**		Surface Dispersants Operational Plan.

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
			Consider need to mobilise vessels for surface dispersant application, including: • Woodside drilling support and offtake • support vessels on / off location • Woodside Exmouth pilot vessel • Regional mutual aid vessel Consider need to mobilise fixed wing aerial dispersant platforms Consider need to mobilise OSRL Hercules C130	Logistics, Marine and Planning	One aircraft with minimum payload of 1,850 litre mobilised to site within four hours of activation. One additional aircraft mobilised to site within another 20 hours of activation. Access to 5,000 m^3 of dispersant on activation of GDS membership within 24-48 hours. **DAY 2:** Four additional aircraft mobilised to site within 48 hours of activation. One high capacity aircraft with minimum payload of 10 m^3 available to spray on day two. Two offtake support vessels will undertake dispersant trials within 48 hours of the release.		
Mechanical Dispersion	No	No	This technique is not recommended. It is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages. The volatile nature of the oil is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.				

Response Strategies	Hydrocarbon Type: Marine Diesel	Hydrocarbon Type: Enfield Crude	Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
Containment and Recovery	No	Potentially	Equipment from Woodside, AMOSC, DoT and AMSA Western Australian Stockpiles and relevant personnel mobilised. Mobilisation of rapid sweep systems (NOFI Buster Series, Desmi speed Sweep etc should be prioritised to increase encounter rates) Consideration of mobilisation of interstate/international containment and recovery equipment and relevant personnel (i.e. OSRL). Mobilisation of rapid sweep systems (including NOFI Buster Series and Desmi speed Sweep) should be prioritised to increase encounter rates.	Logistics and Planning	**DAY 2:** Two vessel-based containment and recovery operations deployed. Four containment and recovery teams available by day five.		Containment and Recovery Operational Plan
In Situ Burning	No	No	This technique is not recommended. It requires calm sea state conditions which limits its feasibility in the region. 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	Yes	Yes	Woodside will mobilise and begin the shoreline protection and deflection response to reduce the	Operations and Planning	**DAY 1:**		Protection and Deflection Operational Plan

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
and Deflection			volume of oil at shorelines by deploying protection and deflection equipment at selected RPA shorelines within 48 hours (first impact predicted to be in 2.25 day at Ningaloo Coast North (diesel scenario) and 21 days at Mangrove Bay (loss of well containment scenario). Equipment from Woodside, AMOSC and AMSA Western Australian Stockpiles mobilised. Consideration of mobilisation of interstate/international shoreline protection equipment (i.e. OSRL).		In agreement with WA DoT, activate relevant Tactical Response Plans (TRPs) within 12 hours. In agreement with WA DoT, mobilise teams to RPAs within 12 hours of operational monitoring predicting impacts. In agreement with WA DoT, equipment mobilised from closest stockpile within 24 hours. **DAY 2:** Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 48 hours.		*Logistics to download immediately and follow steps* Tactical Response Plans *(TRP) available from*: *Oil Spill Portal – Tactical Response Plans* Relevant TRPs: Mangrove Bay Turquoise Bay Yardie Creek Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek Barrow and Lowendal Islands Montebello Island - Stephenson Channel Nth Tactical Response Plan 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 Barrow and Lowendal Islands TRP

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
							Pilbara Islands - Southern Island Group TRP Shark Bay Areas 1-11 TRPs Muiron Islands TRP
			Mobilise security provider as per security support plan.				Land Based Security Support Plan
Shoreline Clean Up	Yes	Yes	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).	Logistics and Planning	**DAY 1:** One shoreline clean-up team to each contaminated RPA within 24 hours. Equipment mobilised from closest stockpile within 12 hours TRPs available for at risk shorelines within 12 hours. **DAY 2:** Access to at least 40-200 m^3 of solid and liquid waste storage available by day 2 and access to an additional 100-500 m^3 by day 3 upon activation of 3rd party contract.		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	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

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
			Consider whether additional equipment is required from local suppliers.				
Scientific Monitoring (Type II)	Yes	Yes	Notify Woodside science team of spill event.	Environment			Oil Spill Scientific Monitoring Programme – Operational Plan
For well integrity event the following strategies apply:							
Well Intervention – SFRT	No	Yes	Debris clearance equipment may require mobilisation prior to the undertaking of any further source control activities. Source control via ROV intervention using the LWI well control package or subsea tree may be feasible. Suitable for Credible Scenario-01 and Credible Scenario-03.	Operations, Logistics and Drilling and Completions (source control)	**DAY 2:** Remotely Operated Vehicle (ROV) on Mobile Offshore Drilling Unit (MODU) ready for deployment within 48 hours		Source Control and Well Intervention Operational Plan
Subsea Dispersant	No	Yes	Consider the need to mobilise suitable support vessel and reeled injection unit. Suitable for Credible Scenario-01 but not Credible Scenario-03.	Operations (Source Control Unit)	**DAY 1:** Equipment to be mobilised within 24 hours if required. Access to 5,000 m^3 of dispersant on activation of GDS membership within 24-48 hours.		Subsea First Response Toolkit (SFRT) and Capping Stack Operational Plan
Capping Stack	No	No	The PAP wells have vertical xmas trees upon which a capping stack cannot be utilised due to incompatibility of connector sizes, inadequate load bearing capacity and/or, if the tree remains in				

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Enfield Crude					
			place, the existing barriers would be remain active.				
Relief Well	No	Yes	As per Nganhurra FPSO Operations – Blowout Contingency Plan.	Operations, Logistics and Drilling and Completions (source control)	**DAY 1:** Identify source control vessel availability within 24 hours. ROV on MODU ready for deployment within 48 hours. Mobile Offshore Drilling Unit (MODU) mobilised to location		Source Control and Well Intervention Operational Plan

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 the sensitive receptors outlined in Table 4-2 are identified as priority protection areas, as they have the potential to be contacted by hydrocarbon at or above impact threshold levels within 48 hours of a spill.

Please note that impact thresholds (10 g/m^2 surface hydrocarbon concentration, 100 g/m^2 shoreline accumulation, and 500 ppb entrained hydrocarbon concentration) used to determine the 'environment that may be affected' (EMBA) identified in the Environment Plan are lower than the response thresholds (Table 4-1).

Table 4-1: Response Thresholds

Surface Hydrocarbon (g/m^2)	Description
>10	Predicted minimum threshold for commencing operational monitoring[2]
50	Predicted minimum floating oil threshold for effective containment and recovery and surface dispersant application[3]
100	Predicted optimum floating oil threshold for effective containment and recovery and surface dispersant application
250	Predicted minimum threshold for effective shoreline clean-up operations

Table 4-2: Receptors for Priority Protection with potential impact within 48 hours (Credible Scenario-05)

Receptor	Distance and Direction from Operational Area (km)	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3	Tactical Response Plans/ Oiled Wildlife Response Plans (also available within the Data Directory)
Ningaloo Coast North	232 km SSE	2.25 days (0.389 m^3)	197.4 m^3 (3.75 days)	• Yardie Creek TRP • Turquoise Bay TRP • Mangrove Bay TRP • Jurabi-Lighthouse Beaches TRP

[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. 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.

Table 4-3: Receptors for Priority Protection with potential impact within 48 hours (Credible Scenario-06)

Receptor	Distance and Direction from Operational Area (km)	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3	Tactical Response Plans/ Oiled Wildlife Response Plans (also available within the Data Directory)
Ningaloo Coast North WHA	200 metres	0.9 days (19 m^3)	139 m^3 (2 days)	• Yardie Creek TRP • Turquoise Bay TRP • Mangrove Bay TRP • Jurabi-Lighthouse Beaches TRP

Hydrocarbon spill modelling results indicate the sensitive receptors listed below have the potential to be contacted by hydrocarbons beyond 48 hours of a spill, although contact is below response thresholds in all cases thus the main technique required will be monitor and evaluate:

- Ningaloo Coast Middle
- Yardie Creek
- Turquoise Bay
- Mangrove Bay
- Jurabi-Lighthouse Beaches
- Shark Bay
- Montebello Islands
- Barrow Island
- Abrolhos Islands
- Muiron Islands
- Pilbara Islands – Southern Islands Group

Tactical Response plans for these locations can be accessed via the Oil Spill Portal - Tactical Response Plans.

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 Nganhurra Cessation of Operations PAP.

Consideration should be given to other stakeholders (including mariners) in the vicinity of the spill location. Table 4-2 indicates the assets within the vicinity of the Nganhurra Cessation of Operations PAP.

Table 4-4: Assets in the vicinity of the Nganhurra Cessation of Operations Operational Areas

Asset	Distance and Direction from Nganhurra FPSO Facility	Operator
Ngujima Yin FPSO	~ 7 km NE	Woodside
Ningaloo Vision FPSO	~10 km NE	Santos
Pyrenees FPSO	~12 km SE	BHP

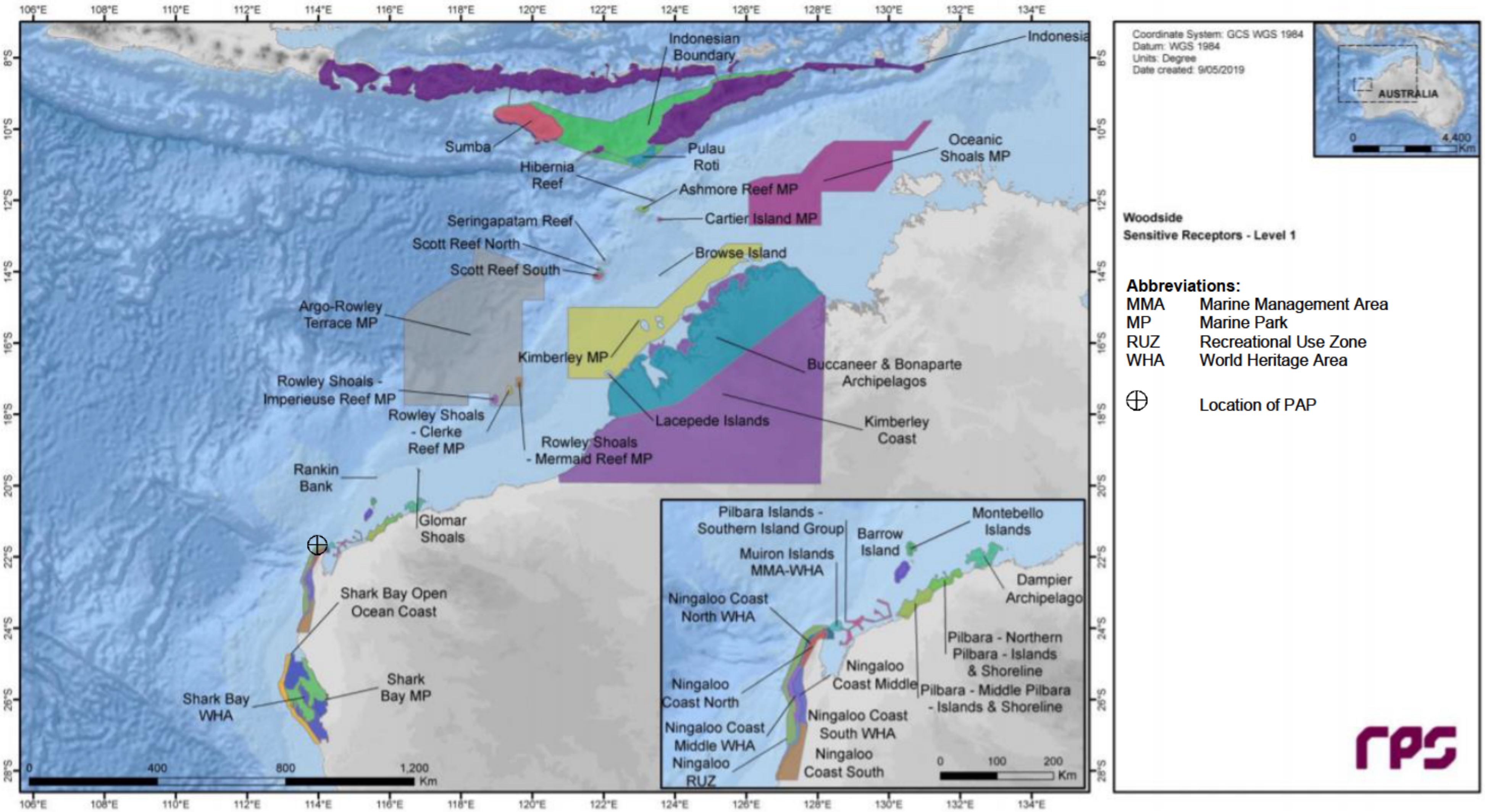


Figure 4-1: Regional sensitive receptors in the vicinity of the Nganhurra Cessation of Operations Operational Areas 1 and 2

5. DISPERSANT APPLICATION

From analysis of the deterministic results, modelling predicts that there is no surface concentration of appropriate hydrocarbon type at 50g/m^2 or 100g/m^2 for the duration of the modelled period (90 days). The lack of sufficient surface threshold concentration would result in surface dispersant spraying being largely ineffective. As a conservative approach, Woodside has included surface dispersant spraying as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed.

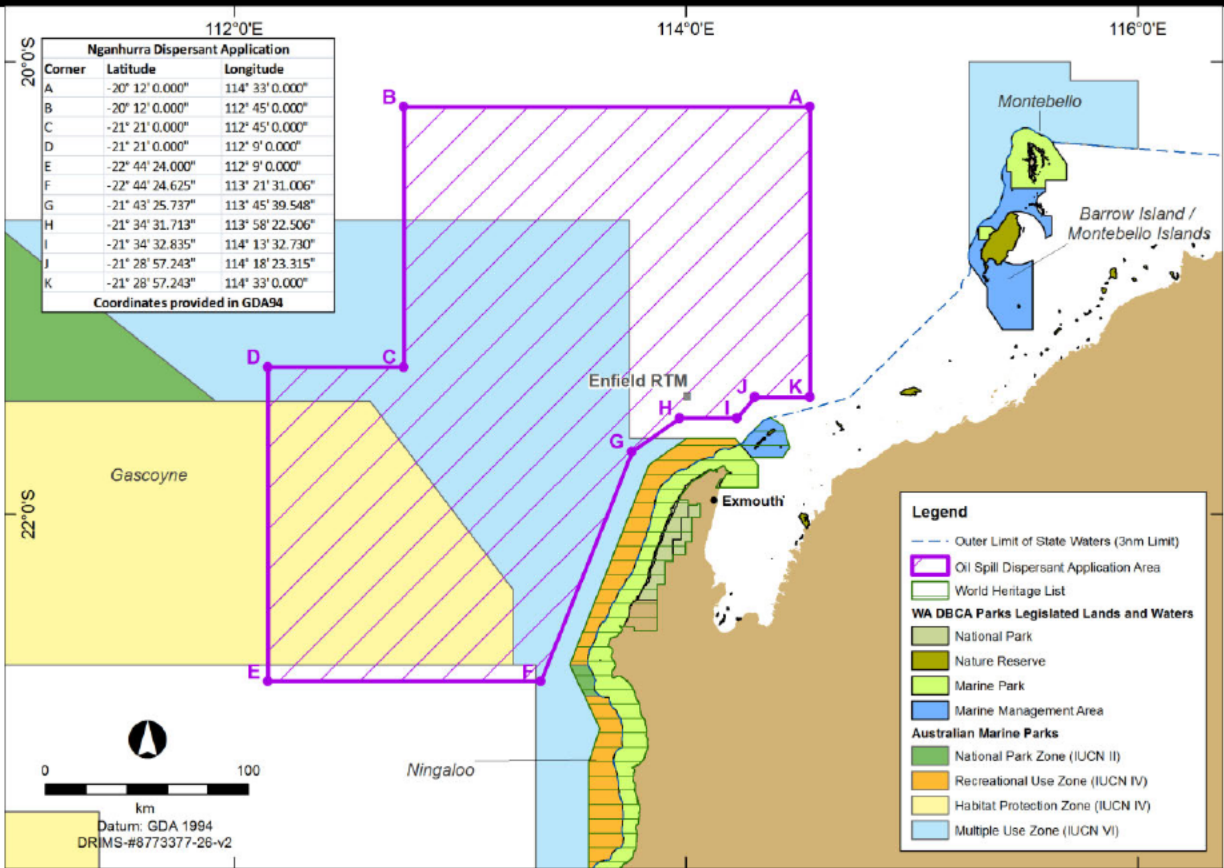
INSTRUCTIONS

DISPERSANTS ARE PRE-APPROVED UNDER THE ENVIRONMENT PLAN FOR USE IN THE PURPLE STRIPED ZONE ONLY. OSCA APPROVED OR TRANSISTIONAL DISPERSANTS ARE PRE-APPROVED FOR USE.

The shape file for the approved dispersant zone is saved in Woodside's Corporate Geodatabase by Geotechnical Operations.

The **SURFACE DISPERSANT OPERATIONAL PLAN** should be used to mobilise dispersant operations immediately – Surface Dispersants Operational Plan

PRE-APPROVED DISPERSANT ZONE



DISPERSANT VOLUMES

Current dispersant volumes available should be checked in the following document:
Oil Spill Preparedness – Dispersant Stockpiles Datasheet

APPENDIX A – CREDIBLE SPILL SCENARIOS AND HYDROCARBON INFORMATION

For more detailed hydrocarbon information see the
Hydrocarbon Data Directory

Credible Spill Scenarios

Scenario	Location	Product	Maximum Volumes	Suggested ADIOS2 Analogue*
Hydrocarbon release caused by a well loss of containment (surface/ subsea) during well intervention/ abandonment. **(235 m^3 per day for 5 days at surface, 184 m^3 per day for 72 days at the seabed)**	Operational Area 1	Enfield crude (API 22.5°)	14,456 m^3	Leona CITGO (API 24.4°)
Hydrocarbon release caused by accidental removal of the subsea Xmas Tree with an ongoing subsea leak via the annulus during well intervention/ abandonment.	Operational Area 1	Enfield crude (API 22.5°)	4897 m^3	Leona CITGO (API 24.4°)
Unplanned hydrocarbon release caused by marine vessel separation.	Operational Area 1	Marine diesel (API 37.2°)	500 m^3	Diesel Fuel Oil (API 37.2°)
Unplanned hydrocarbon release caused by marine vessel collision	Operational Area 2	Marine diesel (API 37.2°)	652 m^3	Diesel Fuel Oil (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 WEL hydrocarbon. Only hydrocarbons with distillation cuts that showed results for >380°C were included in selection process*

Enfield Crude

Enfield Crude (API 22.5°) contains a high proportion (~38% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a high dynamic viscosity (46.0 cP). The pour point of the whole oil (< -36 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

Evaporation rates will increase with temperature, but in general about 3% of the oil mass should evaporate within the first 12 hours; a further 16% should evaporate within the first 24 hours; and a further 43% should evaporate over several days (265 °C < BP < 380 °C).

Selective evaporation will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point.

The whole oil has 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.

In the first 24 hours of a test, variable-wind case, a slightly elevated evaporation rate was observed. The variable-wind case also indicates that wind speeds in excess of 10 m/s do not generate any significant entrainment events, with the majority of the oil mass remaining on the surface at all times. Biological and photochemical degradation is predicted to contribute to the decay of the floating slicks at an approximate rate of 2% per day, for an accumulated total of about 15% after seven days.

Adding this to the loss through evaporation (20-25%) and entrained/dissolved losses (~5%) indicates that the proportion of oil remaining afloat will be around 55-60% after seven days under both light and moderate winds. The bulk of the spilled mass of Enfield Crude that does not evaporate within the first 48 hours will be expected to remain floating on the water surface. Some components of the remaining oil will evaporate and/or degrade over time scales of several weeks to a few months.

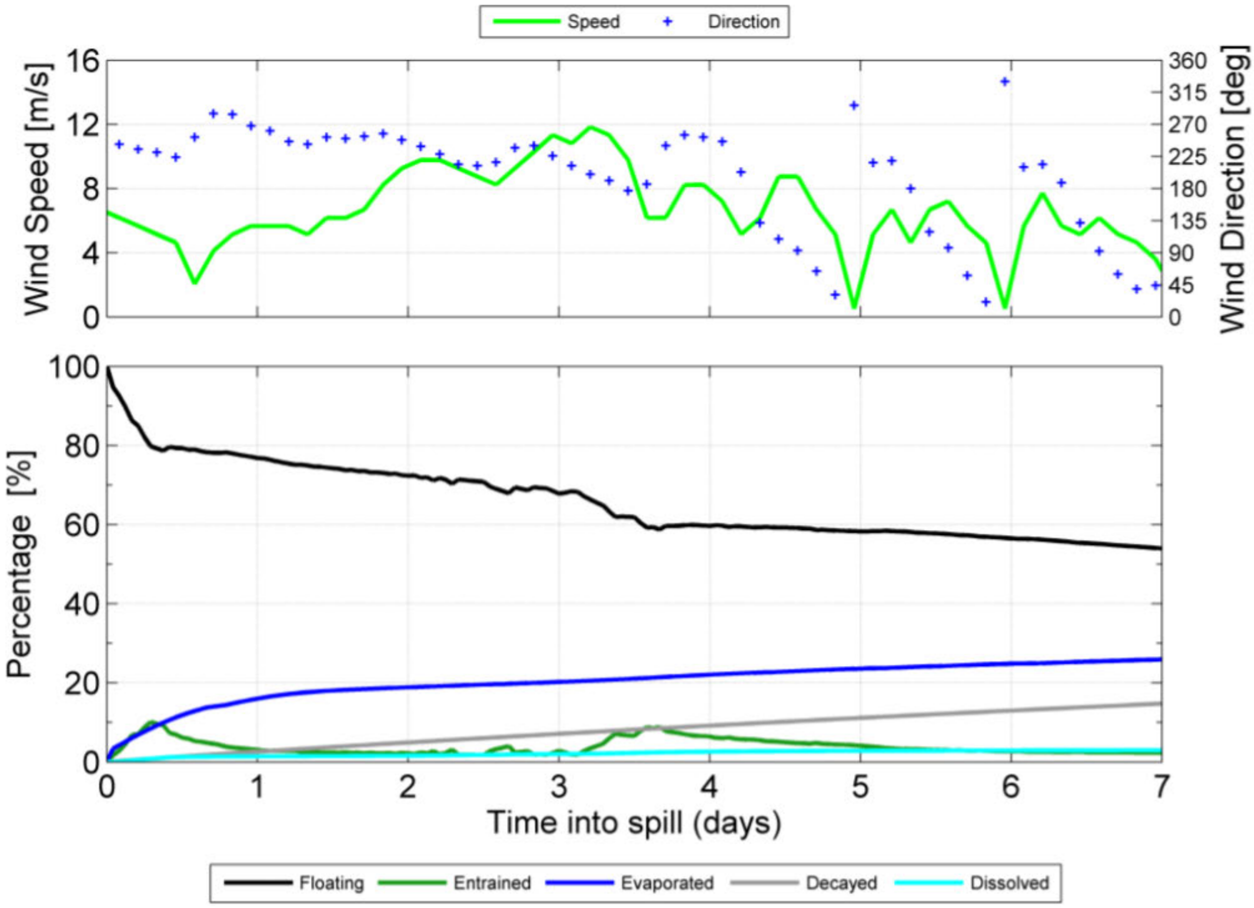


Figure A-1: Proportional mass balance plot representing the weathering of Enfield Crude spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

The results of the OILMAP simulation predicted that the discharge would generate a cone of rising gas that would entrain the oil droplets and ambient sea water up to a "trapping depth" (where the gas plume becomes neutrally buoyant and its vertical velocity drops to zero) approximately 115 m above the seabed and 407 m below the surface. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of 0.8 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone at the neutral buoyancy point is predicted to be approximately 25 m.

The ongoing nature of the release combined with the potential for oil to reach 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 on the ocean surface, with the oil's high viscosity meaning it will tend to resist entrainment under typical local wind conditions.

Marine diesel

Marine diesel (API 37.2°) 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%.

Under the test, variable-wind case, where the winds are of greater strength, entrainment into the water column is indicated to be significant. Approximately 2 days after the spill, around 45% of the oil mass is forecast to have entrained and a further 45% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface. The residual compounds will tend to entrain beneath the surface under conditions that generate wind waves (> ~6 m/s).

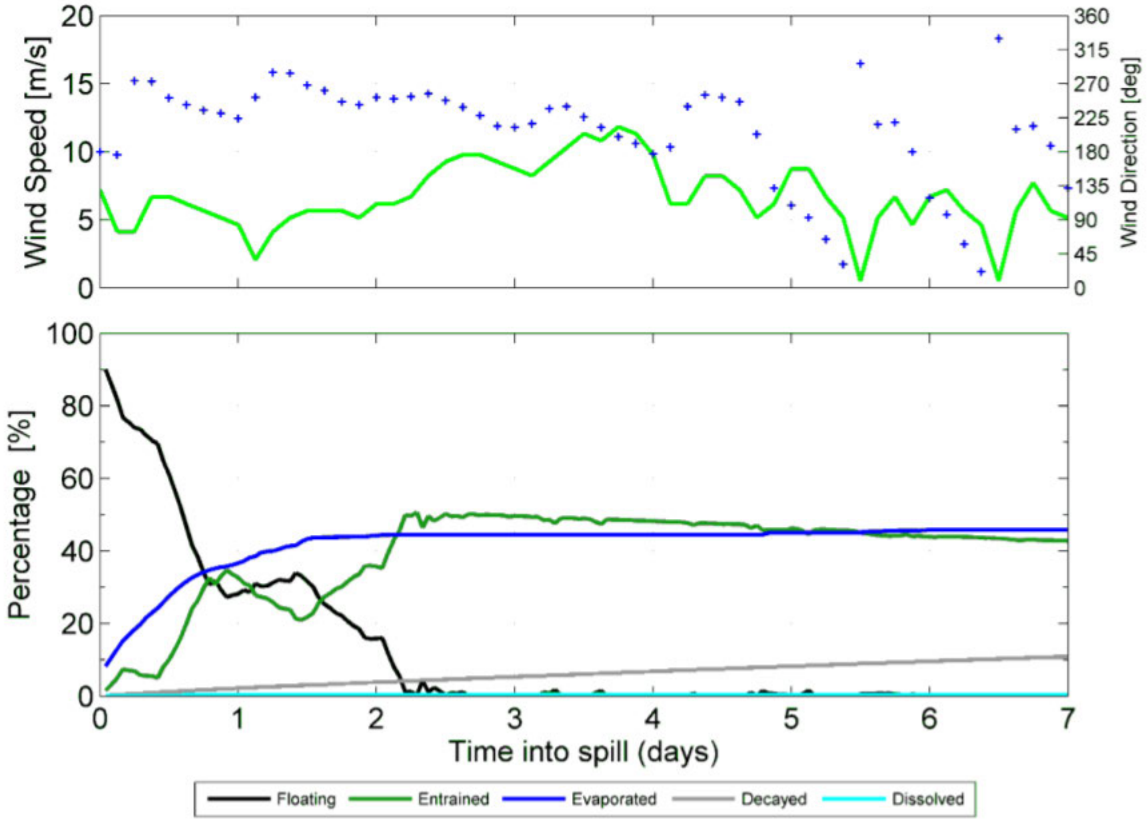


Figure A-2: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

APPENDIX B – FORMS

Form No.	Form Name	Link
1	Record of Initial Verbal Notification to NOPSEMA Template	Link
2	NOPSEMA Incident Report Form	Link
3	Marine Pollution Report (POLREP – AMSA)	Link
4	AMOSC Service Contract Note	Link
5	Marine Pollution Report (POLREP – DoT)	Link
6a	OSRL Initial Notification Form	Link
6b	OSRL Mobilisation Activation Form	Link
7	APASA Oil Spill Trajectory Modelling Request	Link
8	Aerial Surveillance Observer Log	Link

FORM 1

Record of initial verbal notification to NOPSEMA

(NOPSEMA ph: 1300 674 472

Date of call	
Time of call	
Call made by	
Call made to	

Information to be provided to NOPSEMA:

Date and Time of incident/time caller became aware of incident	
Details of incident	1. **Location** ____________ 2. **Title**____________ 3. **Hydrocarbon source** □ **Platform**____________ □ **Pipeline**____________ □ **FPSO**____________ □ **Exploration drilling**____________ □ **Well**____________ □ **Other (please specify)** ____________ 4. **Hydrocarbon type**____________ 5. **Estimated volume of hydrocarbon** ____________ 6. **Has the discharge ceased?**____________ 7. **Fire, explosion or collision?** ____________ 8. **Environment Plan(s)** ____________ 9. **Other Details**____________

Actions taken to avoid or mitigate environmental impacts	
Corrective actions taken or proposed to stop, control or remedy the incident	

After the initial call is made to NOPSEMA, please send this record as soon as practicable to:

1. **NOPSEMA** **submissions@nopsema.gov.au**
2. **NOPTA** **resources@nopta.gov.au**
3. **DMIRS** **petreps@dmirs.wa.gov.au**

FORM 2

[for exploration/development activities]
[insert NOPSEMA Incident Report Form when printing]
Link

FORM 3

[insert Marine Pollution Report (POLREP – AMSA) when printing]

Link

FORM 4

[insert AMOSC Service Contract note when printing]

Link

FORM 5

[insert Marine Pollution Report (POLREP – DoT) when printing]

Link

FORM 6a

[insert OSRL Initial Notification Form when printing]
Link

FORM 6b

[insert OSRL Mobilisation Activation Form when printing]
Link

FORM 7

[insert APASA Oil Spill Trajectory Modelling Request form when printing]
Link

FORM 8

[insert Aerial Surveillance Observer Log when printing]
Link

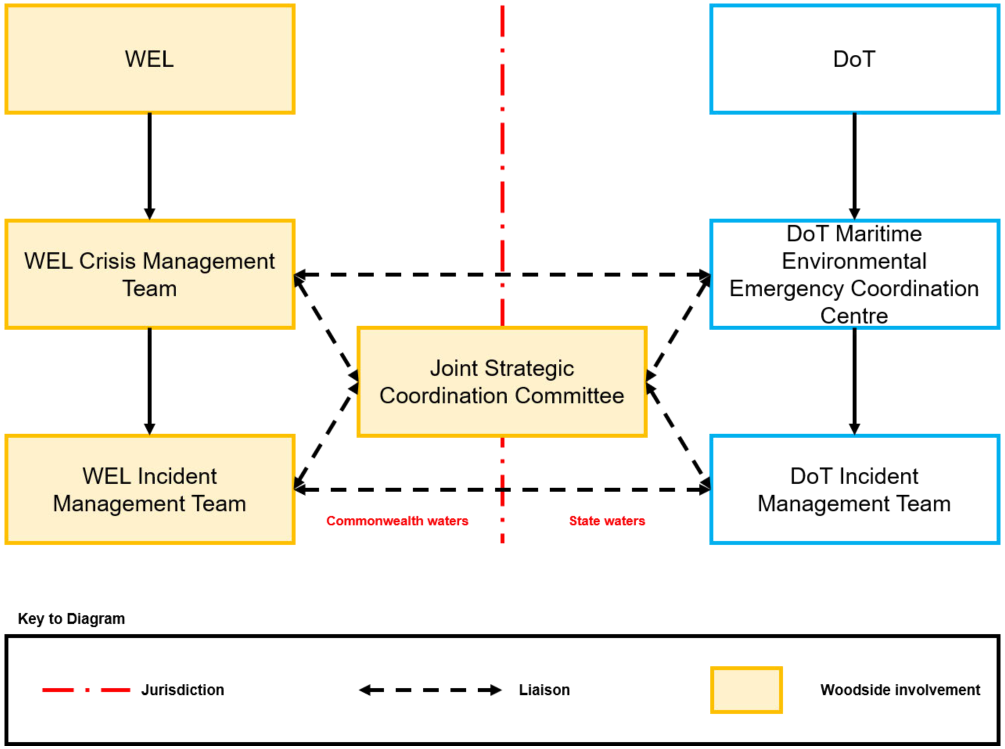
APPENDIX C – 7 QUESTIONS OF SPILL ASSESSMENT

WHAT IS IT? **Oil Type/name** **Oil properties** **Specific gravity / viscosity / pour point / asphphaltines / wax content / boiling point**	
WHERE IS IT? Lat/Long Distance and bearing	
HOW BIG IS IT? Area Volume	
WHERE IT IS GOING? Weather conditions Currents and tides	
WHAT IS IN THE WAY? Resources at risk	
WHEN WILL IT GET THERE? Weather conditions Currents and tides	
WHAT'S HAPPENING TO IT? Weathering processes	

APPENDIX D – TRACKING BUOY DEPLOYMENT INSTRUCTIONS

(Insert Link when printing)

APPENDIX E – COORDINATION STRUCTURE FOR A CONCURRENT HYDROCARBON SPILL IN BOTH COMMONWEALTH AND STATE WATERS/SHORELINES[4]

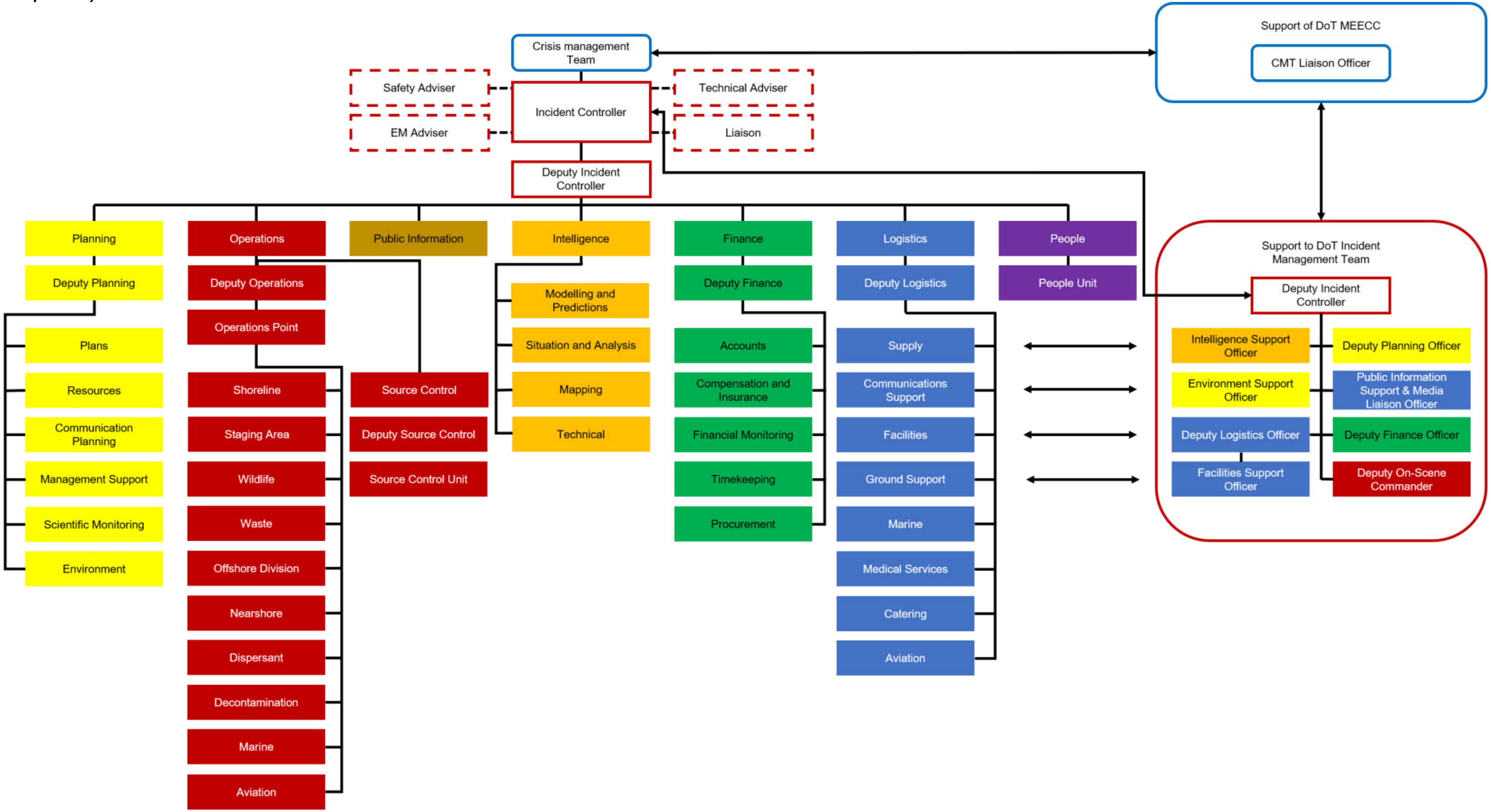


The Control Agency for a hydrocarbon spill in Commonwealth waters/shorelines resulting from an offshore petroleum activity is Woodside (the Petroleum Titleholder). The Control Agency for a hydrocarbon spill in State waters/shorelines resulting from an offshore petroleum activity is DoT. DoT will appoint an Incident Controller and form a separate IMT to only manage the spill within State waters/shorelines.

[4] Adapted from DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements July 2020. Note: For full structure up to Commonwealth Cabinet/Minister refer to Marine Oil Pollution: Response and Consultation Arrangements Section 6.5, Figure 3.

APPENDIX F – WOODSIDE INCIDENT MANAGEMENT STRUCTURE

Woodside Incident Management Structure for Hydrocarbon Spill (including Woodside Liaison Officers Command Structure within DoT IMT if required).



APPENDIX G – WOODSIDE LIASON OFFICER RESOURCES TO DOT

Once DoT activates a State waters/shorelines IMT, Woodside will make available the following roles to DoT.

Area	WEL Liaison Role	Personnel Sourced from[5]:	Key Duties	#
DoT MEECC	CMT Liaison Officer	CMT Duty Managers Roster	• Provide a direct liaison between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT Leader and SMEEC. • Offer advice to SMEEC on matters pertaining to PT crisis management policies and procedures.	1
DoT IMT Incident Control	WEL Deputy Incident Controller	CICC Duty Managers Reserve List Roster	• Provide a direct liaison between the PT IMT and DoT IMT. • Facilitate effective communications and coordination between the PT IC and the DoT IC. • Offer advice to the DoT IC on matters pertaining to PT incident response policies and procedures. • Offer advice to the Safety Coordinator on matters pertaining to PT safety policies and procedures, particularly as they relate to PT employees or contractors operating under the control of the DoT IMT.	1
DoT IMT Intelligence	Intelligence Support Officer/ Deputy Intelligence Officer	AMOSC Staff Member or AMOSC Core Group	• As part of the Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. • Facilitate the provision of relevant modelling and predications from the PT IMT. • Assist in the interpretation of modelling and predictions originating from the PT IMT. • Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the PT IMT. • Facilitate the provision of relevant mapping from the PT IMT. • Assist in the interpretation of mapping originating from the PT IMT. • Facilitate the provision of relevant mapping originating from the DoT IMT to the PT IMT.	1
DoT IMT Intelligence – Environment	Environment Support Officer	CMT Environmental FST Duty Managers Roster	• As part of the Intelligence Team, assist the Environment Coordinator in the performance of their duties in relation to the provision of environmental support into the planning process. • Assist in the interpretation of the PT OPEP and relevant TRP plans. • Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the PT IMT. • Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the PT IMT.	1
DoT IMT Planning-Plans/ Resources	Deputy Planning Officer	AMOSC Core Group/CICC Planning	• 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.	1

[5] See Combined CICC, KICC, CMT roster and Preparedness Schedule Link / AMOSC Service Contract Link

Area	WEL Liaison Role	Personnel Sourced from[5]:	Key Duties	#
		Coordinator Reserve List and Planning Group 3	• Assist in the interpretation of the PT OPEP from the PT. • Assist in the interpretation of the PT IAP and sub plans from the PT IMT. • Facilitate the provision of relevant IAP and sub plans originating from the DoT IMT to the PT IMT. • Assist in the interpretation of the PT existing resource plans. • Facilitate the provision of relevant components of the resource sub plan originating from the DoT IMT to the PT IMT. **(Note this individual must have intimate knowledge of the relevant PT OPEP and planning processes)**	
DoT IMT Public Information-Media/ Community Engagement	Public Information Support and Media Liaison Officer/ Deputy Public Information Officer	CMT Reputation {Media} FST Duty Manager Roster	• As part of the Public Information Team, provide a direct liaison between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. • Assist in the release of joint information and warnings through the DoT Information and Warnings team. • Offer advice to the DoT Media Coordinator on matters pertaining to PT media policies and procedures. • Facilitate effective communications and coordination between the PT and DoT Community Liaison teams. • Assist in the conduct of joint community briefings and events. • Offer advice to the DoT Community Liaison Coordinator on matters pertaining to the PT community liaison policies and procedures. • Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the PT IMT.	1
DoT IMT Logistics ~~Supply~~	Deputy Logistic Officer	CMT Services FST Logistics Team 2 Roster	• As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort. • Facilitate the acquisition of appropriate supplies through the PTs existing OSRL, AMOSC and private contract arrangements. • Collects Request Forms from DoT to action via PT IMT. **(Note this individual must have intimate knowledge of the relevant PT logistics processes and contracts)**	1
DoT IMT Finance-Accounts/	Deputy Finance Officer	CICC Finance Coordinator Roster	• As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through the PTs existing OSRL, AMOSC and private contract arrangements.	1

Area	WEL Liaison Role	Personnel Sourced from[5]:	Key Duties	#
Financial Monitoring			• Facilitate the communication of financial monitoring information to the PT to allow them to track the overall cost of the response. • Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to the PT.	
DoT IMT Operations	Deputy Operations Officer	CICC Operations Coordinator Roster	• As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident. • Facilitate effective communications and coordination between the PT Operations Section and the DoT Operations Section. • Offer advice to the DoT Operations Officer on matters pertaining to PT incident response procedures and requirements. • Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of PT and DoT response efforts.	1
DoT IMT Operations – Waste Management	Facilities Support Officer/ Deputy Waste Management Coordinator	CMT Services FST Logistics Team 2 and WEL Waste Contractor Roster	• As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters. • Facilitate the disposal of waste through the PT's existing private contract arrangements related to waste management and in line with legislative and regulatory requirements. • Collects Request Forms from DoT to action via PT IMT.	1
DoT FOB Operations Command	Deputy On-Scene Commander/ Deputy Division Commander	AMOSC Core Group	• As part of the Field Operations Team, assist the Division Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction. • Provide a direct liaison between the PT FOB and DoT FOB. • Facilitate effective communications and coordination between the PT Division Commander and the DoT Division Commander. • Offer advice to the DoT Division Commander on matters pertaining to PT incident response policies and procedures. • Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to PT employees or contractors. • Offer advice to the Safety Coordinator deployed in the FOB on matters pertaining to PT safety policies and procedures.	1
			Total Woodside personnel initially required in DoT IMT	11

DOT LIAISON OFFICER RESOURCES TO WOODSIDE

Once DoT activates a State waters/shorelines IMT, DoT will make available the following roles to Woodside:

Area	DoT Liaison Role	Personnel Sourced from:	Key Duties	#
WEL CMT	DoT Liaison Officer (prior to DoT assuming Controlling Agency) / Deputy Incident Controller – State waters (after DoT assumes Controlling Agency)	DoT	• Facilitate effective communications between DoT's SMEEC / Incident Controller and the Petroleum Titleholder's appointed CMT Leader / Incident Controller. • Provide enhanced situational awareness to DoT of the incident and the potential impact on State waters. • Assist in the provision of support from DoT to the Petroleum Titleholder. • Facilitate the provision technical advice from DoT to the Petroleum Titleholder Incident Controller as required.	1
WEL Reputation FST (Media Room)/ Public Information – Media	DoT Media Liaison Officer	DoT	• Provide a direct liaison between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. • Assist in the release of joint information and warnings through the DoT Information & 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