Okha
Floating Production Storage and Offtake Facility
Operations Environment Plan

Production Division
Revision 7
July 2020

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 Overview

Woodside Energy Limited (Woodside) is the operator of the Okha floating production, storage and offtake (FPSO) facility and infrastructure in the Cossack, Wanaea, Lambert, and Hermes (CWLH) fields, located off the coast of Western Australia (WA) in Production Licences WA-16-L, WA-9-L, WA-11-L. The fields lie 125–145 km north-west of Karratha, on the inner continental shelf in water depths of 75–135 m.

The Okha FPSO is located in 80 m of water, stationed over the central area of the Wanaea field, ~32 km east of the North Rankin Complex (NRC) and 54 km east of the Goodwyn Alpha (GWA) platform. The subsea production systems comprise thirteen wells linked to subsea manifolds through flexible jumper tie-ins. The Okha FPSO is connected to the subsea infrastructure through a riser turret, subsea risers, and mooring system, and exports gas to North Rankin Alpha (NRA) through the Wanaea Cossack gas export pipeline (WC GEL) where it is subsequently transported to the Karratha Gas Plant (KGP).

The Okha processing system has been designed for a maximum throughput of 60,000 bbl of oil per day, and treatment of 100,000 bbl of produced water (PW) per day (total fluid limit is 150,000 bbl/day). The gas compression system has a maximum capacity of 82 million standard cubic feet per day (MMscfd).

The Okha FPSO was fabricated with a new rigid arm structure, giving it the capability to connect to the riser turret mooring (RTM) system. The RTM system is made up of a riser column, eight anchor chains, and associated gravity anchor boxes, and it allows the vessel to freely weathervane. When connected, the bottom of the column is nominally 30 m above the seabed.

This Environment Plan (EP) has been prepared as part of the requirements under the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (referred to as the Environment Regulations), as administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

In accordance with the requirements of Regulation 19 of the Environment Regulations, Woodside has submitted a revision of the Okha Operations EP to NOPSEMA at least 14 days before the end of the five-year period from the original acceptance under Regulation 11 of the Environment Regulations (i.e. 10 December 2014 – NOSPEMA Reference 2785).

1.2 Defining the Petroleum Activity

The Petroleum Activities Program, outlined in Section 1.4, constitutes a petroleum activity as defined in Regulation 4 of the Environment Regulations. As such, an EP is required.

1.3 Purpose of the Environment Plan

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

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

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

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

1.4 Scope of the Environment Plan

The scope of this EP covers the Petroleum Activities Program for a period of up to five years and includes these activities associated with the Okha FPSO:

- routine production
- routine inspection, monitoring, maintenance and repair (IMMR) of the FPSO and associated subsea infrastructure
- intermittent operations and suspension of production
- supporting activities associated with the activities defined above (e.g. vessel operations, helicopter transfers)
- wet stored subsea infrastructure and temporary abandoned wells
- non-routine and unplanned activities and incidents associated with the above. Drilling activities are not included in the scope of this Environment Plan.

The infrastructure covered by this EP includes the:

- WC GEL
- Okha FPSO (while in the Operational Area)
- RTM mooring system
- associated subsea infrastructure tied back to the Okha FPSO
- wet stored subsea infrastructure
- temporary abandoned wells (exploration and production) Section 3 describes in detail the infrastructure and activities covered by this EP. A decommissioning plan will be developed prior to decommissioning the FPSO and will be submitted to the Environment Regulator for acceptance. The risks associated with removing redundant equipment prior to total FPSO decommissioning will be undertaken and managed in accordance with the requirements of this EP.

1.5 Environment Plan Summary

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

Table 1-1: EP summary

EP Summary material requirement	Relevant section of this EP containing EP Summary material
The location of the activity	Section 3.3, pages 46–46
A description of the receiving environment	Section 4, pages 74–164

EP Summary material requirement	Relevant section of this EP containing EP Summary material
A description of the activity	Section 3, pages 43–74
Details of the environmental impacts and risks	Section 6, pages 181–410
The control measures for the activity	Section 6, pages 181–410
The arrangements for ongoing monitoring of the titleholder's environmental performance	Section 7.5, pages 429–436
Response arrangements in the oil pollution emergency plan	Section 7.8, pages 441–448, and Appendix D
Consultation already undertaken and plans for ongoing consultation	Section 5, pages 164–181
Details of the titleholder's nominated liaison person for the activity	Section 1.8, pages 19–20

1.6 Structure of the Environment Plan

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

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

Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
Regulation 10A(a): is appropriate for the nature and scale of the activity	Regulation 13: Environmental Assessment Regulation 14: Implementation strategy for the environment plan Regulation 16: Other information in the environment plan	The principle of 'nature and scale' applies throughout the EP	Section 0 Section 3 Section 4 Section 5 Section 6 Section 7
Regulation 10A(b): demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable Regulation 10A(c): demonstrates that the environmental impacts and risks of the activity will be of an acceptable level	Regulation 13(1)–13(7): 13(1) Description of the activity 13(2)(3) Description of the environment 13(4) Requirements 13(5)(6) Evaluation of environmental impacts and risks 13(7) Environmental performance outcomes and standards Regulation 16(a)–16(c): A statement of the titleholder's corporate environmental policy A report on all consultations between the titleholder and any relevant person	Set the context (activity and existing environment) Define 'acceptable' (the requirements, the corporate policy, relevant persons) Detail the impacts and risks Evaluate the nature and scale Detail the control measures – ALARP and acceptable	Section 1 Section 0 Section 3 Section 4 Section 5 Section 6 Section 7
Regulation 10A(d): provides for appropriate environmental performance outcomes, environmental performance standards and measurement criteria	Regulation 13(7): Environmental performance outcomes and standards	Environmental Performance Objectives (EPOs) Environmental Performance Standards (EPSs) Measurement Criteria (MC)	Section 6

Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
Regulation 10A(e): includes an appropriate implementation strategy and monitoring, recording and reporting arrangements	Regulation 14: Implementation strategy for the environment plan	Implementation strategy, including: • systems, practices and procedures • performance monitoring • Oil Pollution Emergency Plan (OPEP) and scientific monitoring • ongoing consultation.	Section 7 Appendix D
Regulation 10A(f): does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any 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

Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
Regulation 10A(h): complies with the Act and the regulations	Regulation 15: Details of the Titleholder and liaison person Regulation 16(c): Details of all reportable incidents in relation to the proposed activity.	All contents of the EP must comply with the Act and the regulations	Section 1.6 Section 7.7

1.7 Description of the Titleholder

Woodside is the pioneer of the LNG industry in Australia and one of the largest Australian natural gas producers. Woodside Energy Ltd has a global portfolio and is recognised for its world-class capabilities as an integrated upstream supplier of energy. Woodside is the operator of the Okha FPSO and associated infrastructure in the Cossack Wanaea Lambert Hermes (CWLH) Joint Venture, on behalf of itself and its joint venture participants —BHP Billiton Petroleum (North West Shelf) Pty. Ltd., BP Developments Australia Pty Ltd, Chevron Australia Pty. Ltd, and Japan Australia LNG (MIMI) Pty. Ltd. Temporary abandoned exploration wells (Lambert 5ST1, Cossack-1, Goodwyn-6 and Angel-1) are also operated by Woodside in the North West Shelf (NWS) Joint Venture, on behalf of itself and its joint venture participants—Shell Australia Pty. Ltd., BHP Billiton Petroleum (North West Shelf) Pty. Ltd., BP Developments Australia Pty Ltd, Chevron Australia Pty. Ltd, CNOOC NWS Private Ltd, and Japan Australia LNG (MIMI) Pty. Ltd. Woodside is the Titleholder for this activity (refer to Table 3-1 for a list of petroleum titles associated with the Petroleum Activities Program).

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

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

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

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

1.8 Details of Titleholder, Liaison Person and Public Affairs Contact

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

1.8.1 Titleholder

Woodside Energy Limited

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

ACN: 63 005 482 986

1.8.2 Activity Contact

Gerard Ransom

Okha FPSO Asset Manager

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

E: feedback@woodside.com.au

1.8.3 Nominated Liaison Person

Daniel Clery

Corporate Affairs Manager

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

E: feedback@woodside.com.au

1.8.4 Arrangements for Notifying Change

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

1.9 Woodside Management System

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

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

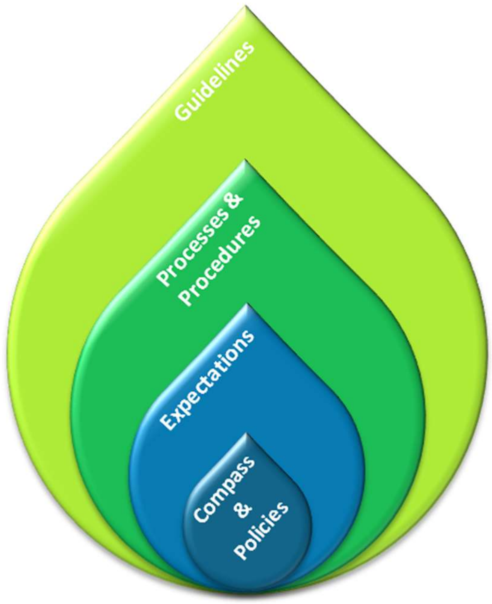

Figure 1-1: The four major elements of the WMS Seed

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

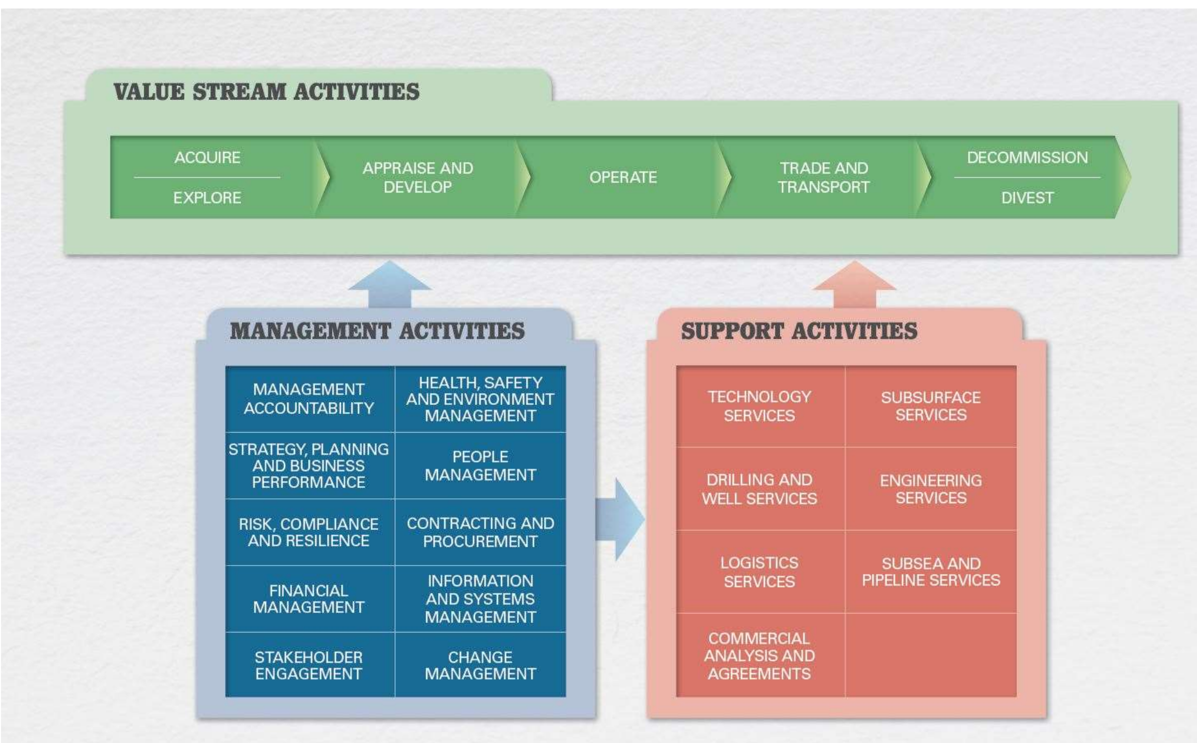

Figure 1-2: The WMS business process hierarchy

1.9.1 Health, Safety, Environment and Quality Policy

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

1.10 Description of Relevant Requirements

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

1.10.1 Applicable Environmental Legislation

1.10.1.1 Offshore Petroleum and Greenhouse Gas Storage Act 2006

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

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

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

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

Part of a normal offshore petroleum project's lifecycle includes decommissioning. Prior to title relinquishment, under subsection 270(3), 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. This includes the requirement to plug or close off all wells to the satisfaction of NOPSEMA.

Complete removal of all infrastructure from the title area is contemplated under subsection 572(3) of the OPGGS Act. Timely and effective planning for decommissioning is ongoing throughout the asset's lifecycle and includes planning for decommissioning of property at the end of production, and decommissioning of disused or redundant infrastructure at appropriate points throughout the life of an asset.

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.

1.10.1.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is administered by the Commonwealth 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.

This EP will not be assessed under the EPBC Act as the activity is not a controlled action and does not impact upon MNES or biodiversity.

1.10.2 Australian Marine Parks

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

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

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

1.10.3 World Heritage Properties

Australian World Heritage management principles are prescribed in Schedule 5 of the EPBC Regulations 2000. Management principles that are considered relevant to the scope of this EP are provided in Table 1-3.

Table 1-3: 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:	3.01 and 3.02: Assessment of significant impact on World Heritage values is included in Section 6. Principles are met by the submitted EP. 3.03 (a) and (b): World Heritage values are identified in Section 4 and considered in the assessment of impacts and risks

	(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.	for the Petroleum Activity in Section 6. 3.03 (c): Relevant stakeholder consultation and feedback received in relation to impacts and risks to the Ningaloo World Heritage Property are outlined in Section 5. 3.04, 3.05 and 3.06: Principles are considered to be met by the acceptance of this EP.

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

2. ENVIRONMENT PLAN PROCESS

2.1 Overview

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

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

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

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

In this EP:

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

2.2 Environmental Risk Management Methodology

2.2.1 Woodside Risk Management Process

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

The environmental risk management methodology used in this EP is based on Woodside's Risk Management Procedure (Woodside Doc No. WM0000PG10055394). This procedure aligns to industry standards, such as international standard ISO 31000:2009. Woodside's WMS risk management procedures, guidelines and tools provide guidance of specific techniques for managing risk, tailored for particular areas of risk within certain business processes. Procedures applied for environmental risk management include:

- Health, Safety and Environment Management Procedure (Woodside Doc No. WM0000MG10347354)
- Impact Assessment Procedure (Woodside Doc No. WM0000PG10996761)
- Process Safety Management Procedure (Woodside Doc No. WM0000PG9905457).

The risk management methodology provides a framework to demonstrate that risks and impacts are continually identified, reduced to ALARP and assessed to be at an acceptable level, as required by the Environment Regulations. The key steps of Woodside's Risk Management Process are shown in Figure 2-1. A description of each step and how it is applied to the scopes of this activity is provided in Sections 2.2 to 2.11.

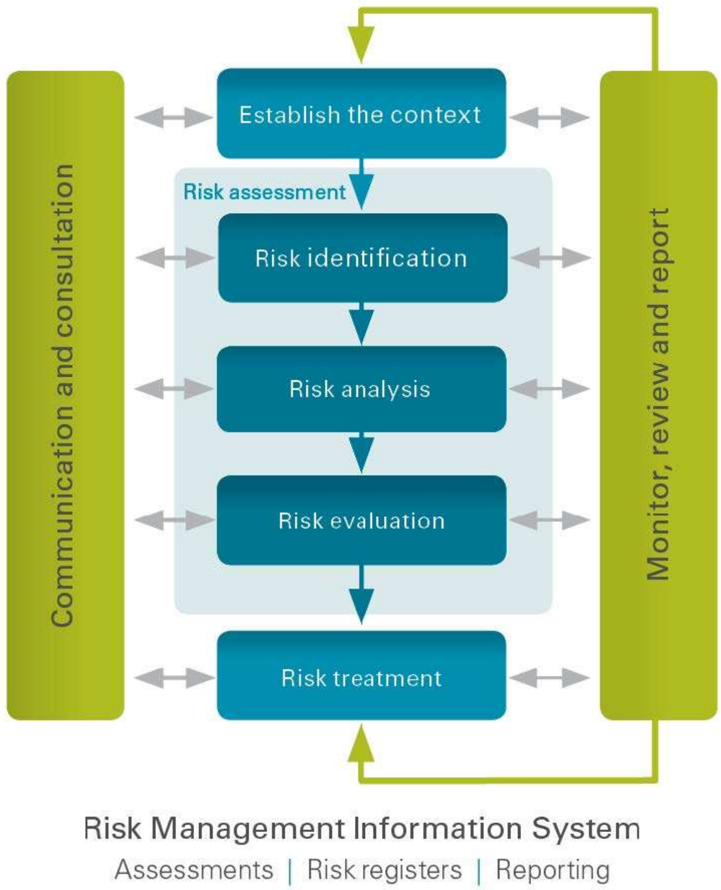

Figure 2-1: Woodside's risk management process

2.2.2 Health, Safety and Environment Management Procedure

The Health, Safety and Environment Management Procedure (Woodside Doc No. WM0000MG10347354) provides the structure for managing health, safety and environment (HSE) risks and impacts across Woodside, defines the decision authorities for company-wide HSE management activities and deliverables, and supports continuous improvement in HSE management.

2.2.3 Impact Assessment Procedure

To support effective environmental risk assessment, Woodside's Impact Assessment Procedure (Woodside Doc No. WM0000PG10996761) (Figure 2-2) provides the steps to meet the required environment, health and social standards by ensuring impact assessments are undertaken appropriate to the nature and scale of the activity, the regulatory context, the receiving environment, interests, concerns and rights of stakeholders, and the applicable framework of standards and practices.

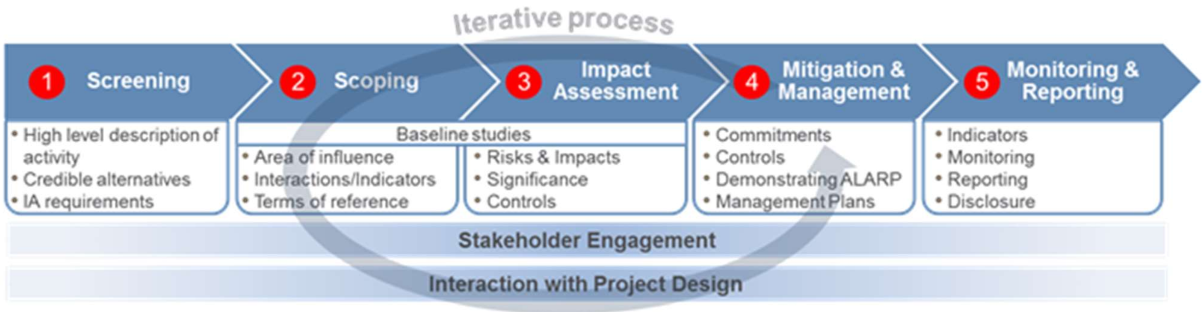

Figure 2-2: Woodside's impact assessment process

2.2.4 Process Safety Management Procedure and Process Safety Risk Assessment Procedure

Due to the nature and scale of petroleum activities, Woodside's Process Safety Management Procedure (Woodside Doc No. WM0000PG9905457) establishes Woodside's framework for Process Safety Management (Section 7.1.2). This framework includes the Process Safety Risk Assessment Procedure (Woodside Doc No. WM0000PG10137463) (PSRA). The PSRA is a key part of Woodside's process safety management framework for managing the integrity of systems and processes that handle hazardous substances over the exploration and production lifecycle. The PSRA sets out methods to ensure that process safety risks are understood and controlled, including that all process safety hazards are systematically identified, assessed and treated so that the associated risks are reduced to a level that is tolerable and ALARP.

2.3 Environment Plan Process

Figure 2-3 illustrates the EP development process. Each element of this process is discussed further in Sections 2.5 to 2.10.

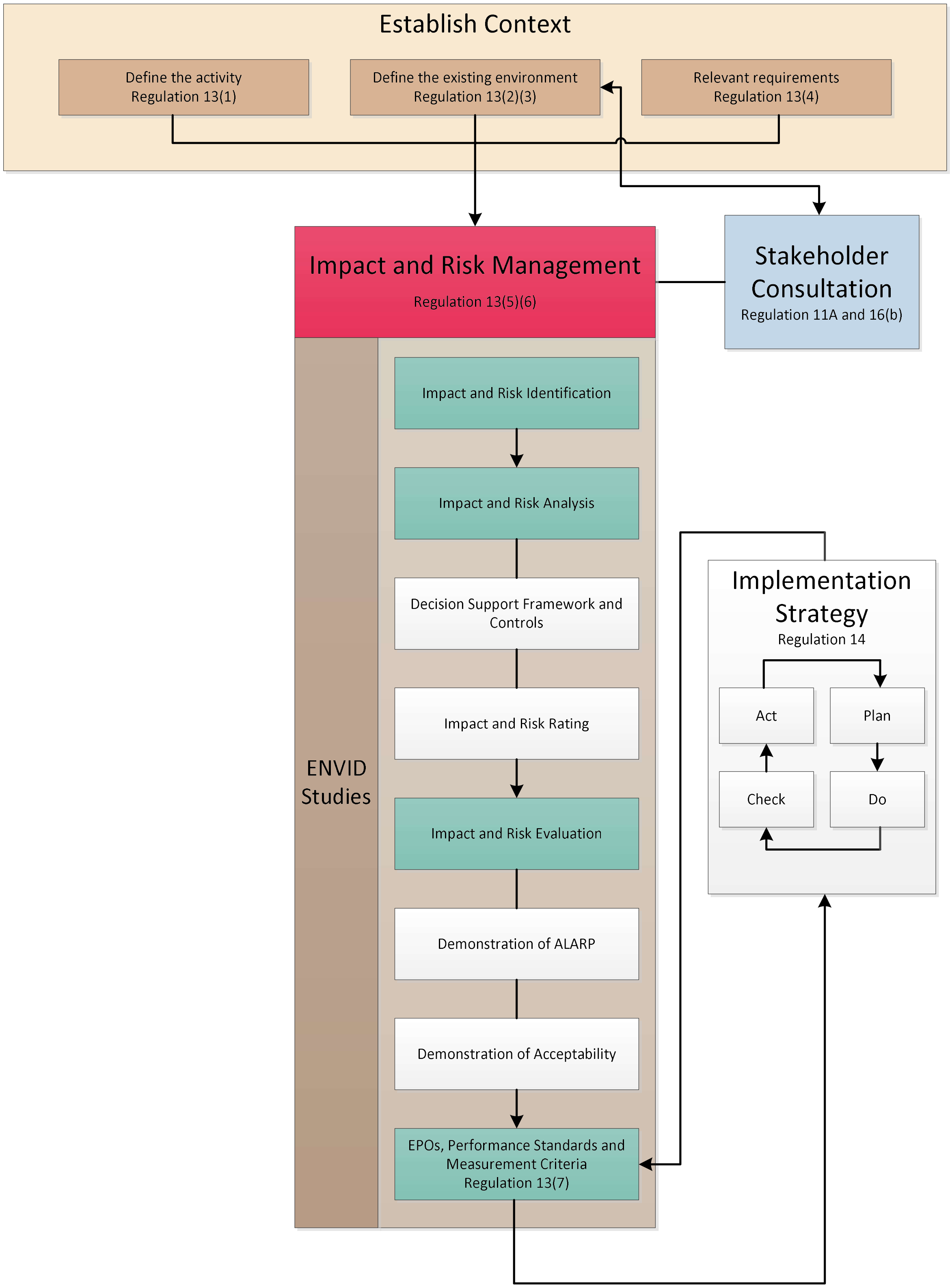

Figure 2-3: Environment Plan development process

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 described in relation to:

- the location
- what is to be undertaken, including general details such as the construction and layout of the facility
- how it is planned to be undertaken, including outlining operational details of the activity and proposed timeframes.

The 'what' and 'how' are described in the context of 'environmental aspects'[1] to inform the risk and impact assessment for planned (routine and non-routine) and unplanned (accidents/incidents/emergency conditions) activities.

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

2.4.2 Define the Existing Environment

The context of the existing environment is described and determined by considering the nature and scale of the activity (size, type, timing, duration, complexity, and intensity of the activity), as described in Section 3. The purpose is to describe the existing environment that may be impacted by the activity, directly or indirectly, by planned or unplanned[2] events.

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

- The environmental, and social and cultural consequences as defined by Woodside (refer to Table 2-1), which address key physical and biological attributes, as well as social and cultural values of the existing environment. These consequence definitions are applied to the impact and risk analysis (refer Section 2.2) and rated for all planned and unplanned activities. Additional detail is provided for unplanned hydrocarbon spill risk evaluation.
- EPBC Act MNES including listed threatened species and ecological communities and listed migratory species. Defining the spatial extent of the existing environment is guided by the nature and scale of the Petroleum Activities Program (and associated sources of environmental risk). This considers the Operational Area and wider environment that may be affected (EMBA), as determined by the hydrocarbon spill risk assessments presented in Section 6.8. MNES, as defined within the EPBC Act, are addressed through Woodside's impact and risk assessment (Section 6).
- Relevant values and sensitivities, which may include world or national heritage listed areas, listed threatened species or ecological communities, listed migratory species, or sensitive values.

By grouping potentially impacted environmental values by aspect (as presented in Table 2-1), the presentation of information about the receiving environment is standardised. This information is then

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

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

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

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

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

2.4.3 Relevant Requirements

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

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

2.5 Impact and Risk Identification

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

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

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

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

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

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

2.6 Impact and Risk Analysis

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

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

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

2.6.1 Decision Support Framework

To support the risk assessment process and Woodside's determination of acceptability (Section 2.8.2), Woodside's HSE risk management procedures include the use of a decision support framework based on principles set out in the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This concept was applied during the ENVID, or equivalent processes during historical design decisions, to determine the level of supporting evidence that may be required to draw sound conclusions regarding risk level and whether the risk is acceptable and ALARP (Figure 2-4). Application of the decision support framework confirms:

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

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

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

2.6.1.1 Decision Type A

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

2.6.1.2 Decision Type B

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

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

2.6.1.3 Decision Type C

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

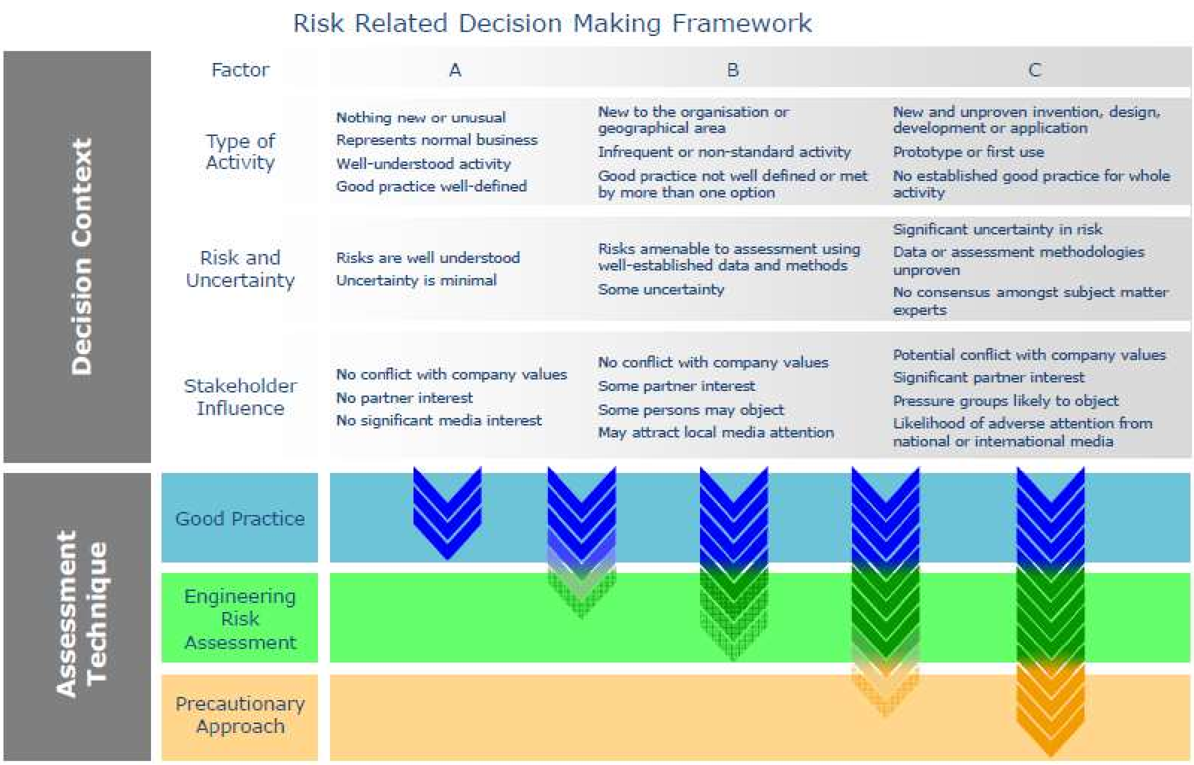

Figure 2-4: Risk-related decision-making framework

Source: Oil and Gas UK (2014)

2.6.1.4 Decision Support Framework Tools

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

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

Decision Calibration

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

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

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

2.6.2 Control Measures (Hierarchy of Controls)

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

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

2.6.3 Impact and Risk Classification

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

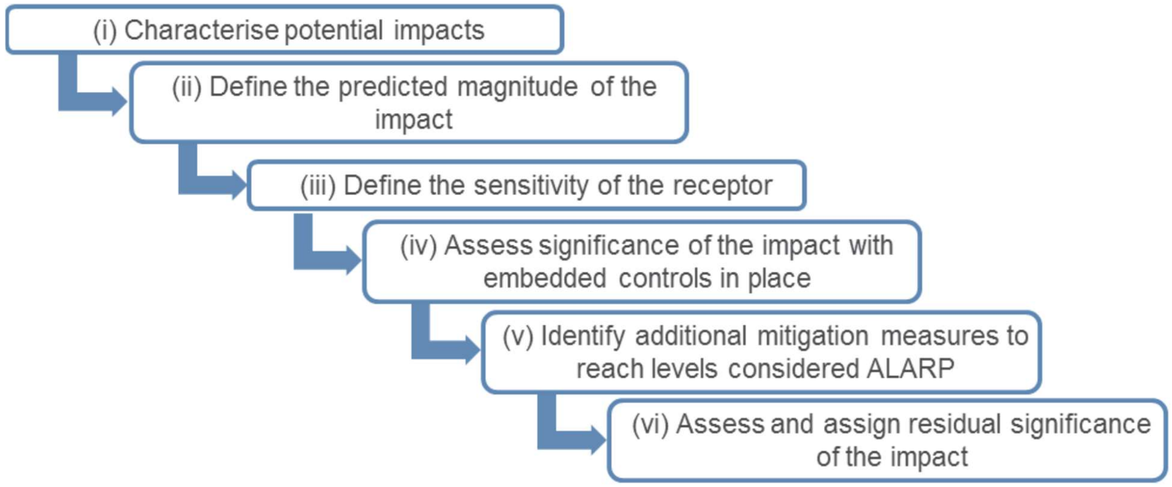

Figure 2-5: Environmental risk and impact analysis

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

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

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

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

2.6.3.1 Risk Rating Process

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

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

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

Select the Consequence Level

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

Select the Likelihood Level

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

Table 2-4: Woodside risk matrix likelihood levels

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

Calculate the Risk Rating

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

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

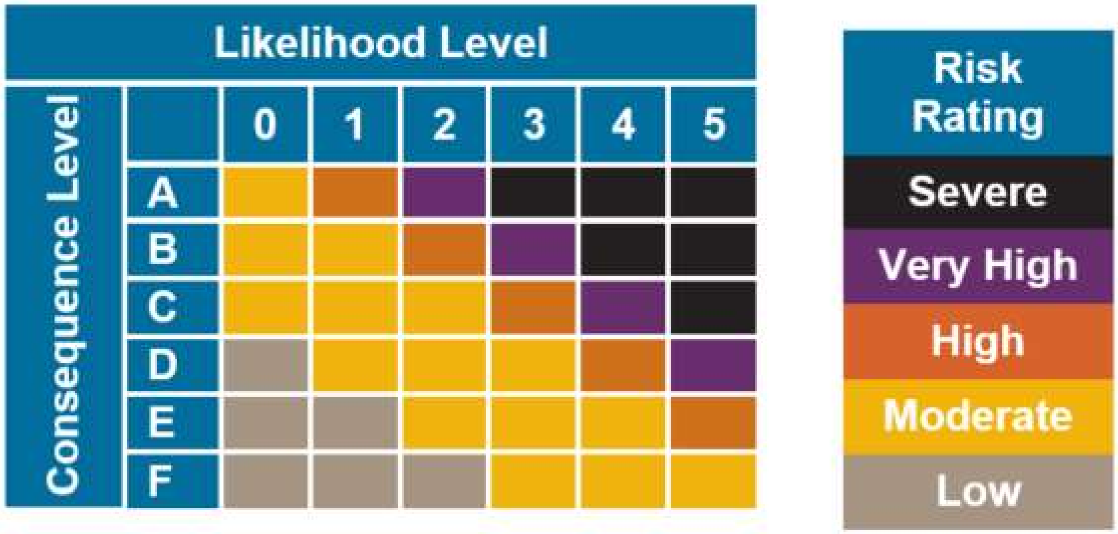

Figure 2-6: Woodside risk matrix – risk level

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

2.7 Classification and Analysis of Major Environment Events

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

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

2.7.1 MEE Identification

The ENVID and risk rating process generates numerous sources of risk with differing consequence levels. Not all these risks meet the MEE definition; therefore, they are screened out at this stage of the MEE process.

Although these risks are screened out, all risks identified in this EP (including MEEs), are evaluated for ALARP and acceptability using the methodology described in Section 2.8.

2.7.2 MEE Classification

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

2.7.3 Bowtie Analysis

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

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

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

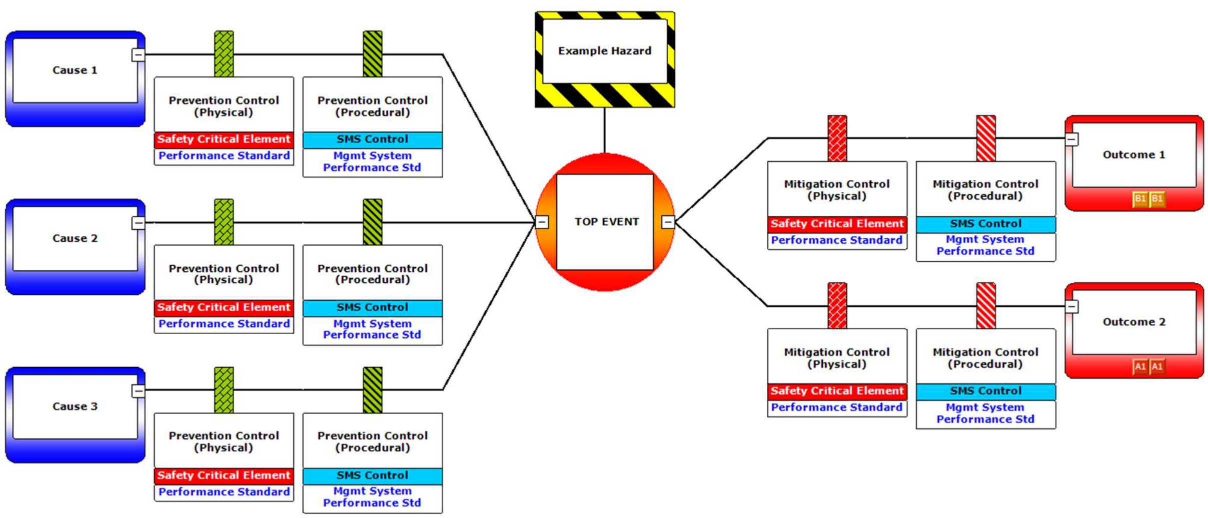

Figure 2-7: Example of bowtie diagram structure

2.7.4 MEE Register

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

Potential common causes that contribute to MAEs/MEEs, or that can result in failure or degradation of the controls in place to protect against MAEs/MEEs, include some generic mechanisms of SCE failure and generic human error. These are represented in bowties applicable to multiple MEEs. The generic SCE failure bowtie illustrates the causes, outcomes and controls in place to manage potential failure mechanisms. Human errors are managed via the WMS. The Generic Human Error bowtie is included in the MEE Register.

2.7.5 Safety and Environment Critical Elements (SCEs) and SCE Technical Performance Standards

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

Once each SCE is selected, technical performance requirements are developed in accordance with the Safety and Environment Critical Element (SCE) Management Procedure (Woodside Doc No. WM1040PF9809289) and form the SCE technical performance standards. These standards are a statement of the performance required of an SCE (e.g. functionality, availability, reliability, survivability). They are used to establish agreed assurance tasks for each SCE, support the management of operations within acceptable safety and/or environment risk levels, and ensure continuous management of risk to ALARP. An assurance task is an activity carried out by the operator to confirm that the SCE meets, or will meet, its SCE Performance Standard. Examples of assurance tasks include inspection routines, maintenance activities, test routines, instrumentation calibration, and reliability monitoring.

SCE Technical Performance Standards do not always align directly with EPSs. They are used in conjunction with the WMS to identify and treat potential step-outs from expected controls performance or integrity envelopes and ensure SCE performance can be optimised. Woodside's HSE Event Reporting Guideline (Woodside Doc No. WM0000MG9905230) describes the process for identifying 'Damage to SCEs', which is an SCE failure presenting a risk level that requires Immediate Control Actions be put in place to manage increased current risk (see Section 7.1.5). For applicable SCEs, 'Damage to SCE' failures represent scenarios that may fail to achieve an EPS presented in this EP.

Section 6.8.2 of this EP presents the results of the MEE classification and analysis for the Okha facility. More detail on the SCE and Performance Standards process, and the interrelationships to other parts of the SCE Management Procedures, is described in Section 7.1.5.

2.7.6 Safety-critical Management System Barriers

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

2.8 Impact and Risk Evaluation

Environmental impacts and risks cover a wider range of issues, differing species, persistence, reversibility, resilience, cumulative effects, and variability in severity than safety risks. Determining the degree of environmental risk, and the corresponding threshold for whether a risk/impact has

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

been reduced to ALARP and is acceptable, is evaluated to a level appropriate to the nature and scale of each impact or risk. Evaluation includes considering the:

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

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

2.8.1 Demonstration of ALARP

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

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

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

2.8.2 Demonstration of Acceptability

The descriptions in Table 2-6 articulate how Woodside demonstrates how different risks, impacts and Decision Types identified within the EP are Acceptable (refer to Figure 2-8 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 using opportunistic measures) is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained.		

Risk	Impact	Decision Type
High, Very High or Severe	**Moderate and above (D, E or F)**	**B and C**
Woodside demonstrates these higher-order risks, impacts and decision types are 'Acceptable if ALARP' where it can be shown good industry practice and RBA have been employed, 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 ESD – as defined under the EPBC Act • internal context – ensuring the proposed controls and consequence/risk level are consistent with Woodside policies, procedures and standards • external context – considering the environment consequence (Section 6) • stakeholder acceptability (Section 7) • other requirements – ensuring the proposed controls and consequence/risk level are consistent with national and international standards, laws and policies. *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 to accept the risk in accordance with Woodside's Risk Management Procedure. This includes due consideration of regulatory requirements.*		

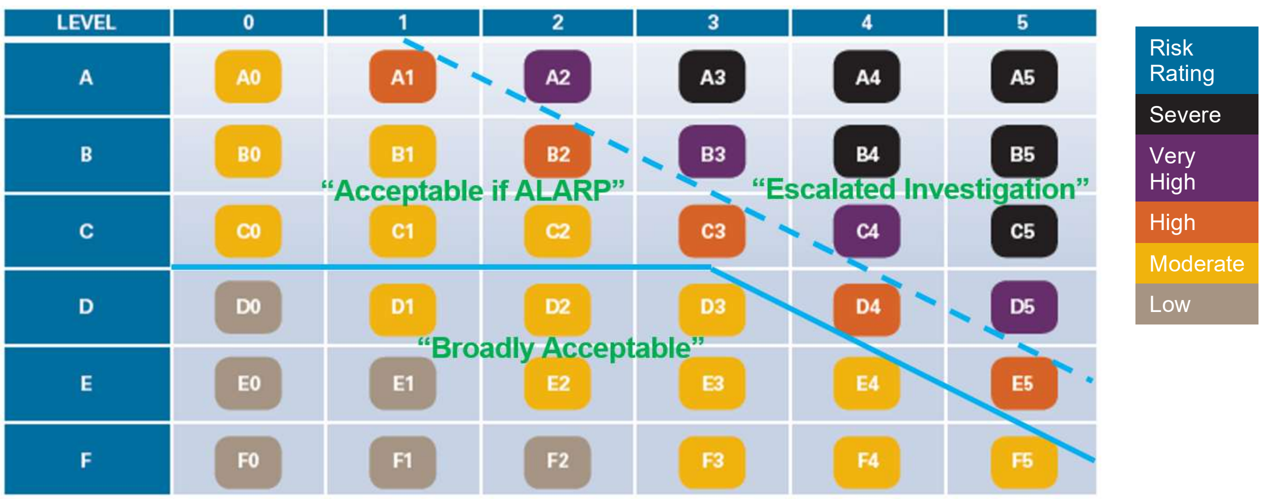

Figure 2-8: Environmental risk evaluation

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

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

2.10 Implement, Monitor, Review and Reporting

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

- control measures are effective in reducing the environmental impacts and risks of the Petroleum Activities Program to ALARP and Acceptable levels
- EPOs and EPSs set out in the EP are met through monitoring, recording, auditing, managing non-conformance, and reviewing

- all environmental impacts and risks of the Petroleum Activities Program are periodically reviewed in accordance with Woodside's risk management procedures
- roles and responsibilities are clearly defined, and personnel are competent and appropriately trained to implement the requirements set out in this EP, including in emergencies or potential emergencies
- arrangements are in place for oil pollution emergencies, to respond to and monitor impacts
- environmental reporting requirements are met, including 'reportable incidents'
- appropriate stakeholder consultation is undertaken throughout the activity.

The implementation strategy is presented in Section 7.

2.11 Stakeholder Consultation

A stakeholder assessment is undertaken to identify relevant people (as defined under Regulation 11A of the Environment Regulations) to whom an activity update is issued electronically; reasonable consultation periods are included. Further details and information 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. A copy of the full text correspondence with relevant people is provided in Appendix F.

3. DESCRIPTION OF THE ACTIVITY

3.1 Overview

This section has been prepared in accordance with Regulation 13(1) of the Environment Regulations and describes the activities to be undertaken as part of the Petroleum Activities Program under this EP. It includes the location of the activity, general details of the facility's layout, the operational details of the activity, and additional information relevant to consideration of environmental risks and impacts.

Okha is a standalone FPSO. It is designed to separate, process, store, and offload oil and export gas from the CWLH fields. The FPSO offtakes oil to trading tankers, and gas is transported via the WC GEL and can be directed to either trunkline. The production system comprises subsea wells and infrastructure (e.g. wellheads, Xmas trees, manifolds, umbilicals, flowlines, and risers), an RTM, the FPSO, and the WC GEL.

3.2 Location

The Okha FPSO and associated infrastructure (Table 3-1) is located in Production Licence Areas WA-9-L, WA-11-L, and WA-16-L, and is situated in 80 m of water over the central area of the Wanaea field. The WC GEL operates under Pipeline Licence WA-4-PL, and varies in depth from 80 m at its eastern end (at Okha) to 125 m at its western end (32 km west of the Okha FPSO; within the Operational Area).

Two other temporary abandoned exploration wells (Goodwyn-6 and Angel-1) are located in nearby titles closer to the Goodwyn (WA-5-L) and Angel (WA-3-L) platforms.

The Okha FPSO and associated infrastructure is marked on nautical maps and is surrounded by a 500 m petroleum safety zone (PSZ). The coordinates of the Okha FPSO and associated infrastructure are listed in Table 3-1. There are other exploration wells with wellheads in these titles. These are being managed in consultation and agreement with NOPSEMA.

Table 3-1: Okha FPSO and associated infrastructure locations and petroleum permits

Infrastructure	Water Depth (Approx. m LAT)	Latitude (WGS84)	Longitude (WGS84)	Petroleum Titles
Okha FPSO	80	19° 35′ 20.695″S	116° 26′ 48.651″E	WA-11-L
East end of Okha WC GEL (Okha facility)	76	19°35′20.92″S	116°26′33.75″E	WA-4-PL
West end of Okha WC GEL (NRC facility)	125	19°35′07.14″S	116°08′21.88″E	WA-4-PL
Production Wells				
Cossack-4H (CK4)	81	19° 33′ 22.909″ S	116° 29′ 35.754″ E	WA-9-L
Wanaea-8 (WA8)	83	19° 34′ 40.796″ S	116° 26′ 59.438″ E	WA-9-L
Wanaea-6 (WA6)	82	19° 34′ 41.849″ S	116° 26′ 58.559″ E	WA-9-L
Wanaea-7ST1 (WA7)	82	19° 35′ 31.586″ S	116° 26′ 6.622″ E	WA-11-L
Wanaea-9ST1 (WA9)	80	19° 36′ 45.783″ S	116° 24′ 45.838″ E	WA-11-L
Lambert-4 (LA4)	128	19° 26′ 57.820″ S	116° 29′ 15.427″ E	WA-16-L
Lambert-6 (LH6)	128	19° 26′ 56.873″ S	116° 29′ 16.854″ E	WA-16-L
Lambert-7 (LA7)	129	19° 26′ 57.974″ S	116° 29′ 18.617″ E	WA-16-L
Lambert-3 (LH3)	128	19° 26′ 58.469″ S	116° 29′ 16.227″ E	WA-16-L

Infrastructure	Water Depth (Approx. m LAT)	Latitude (WGS84)	Longitude (WGS84)	Petroleum Titles
Production Wells Temporary Abandoned (PTA)				
Wanaea-1ST1 (WA1)	82	19° 35′ 30.385″ S	116° 26′ 7.466″ E	WA-11-L
Wanaea-2A (WA2)	79	19° 36′ 44.588″ S	116° 24′ 46.054″ E	WA-11-L
Wanaea-3 (WA3)	83	19° 34′ 41.837″ S	116° 27′ 0.216″ E	WA-9-L
Wanaea-11A (WA11)	81	19° 35′ 32.159″ S	116° 26′ 8.927″ E	WA-11-L
Exploration Wells Temporary Abandoned (ETA)*				
Cossack-1	84	19°33′17.129″S	116° 29′ 50.555″E	WA-9-L
Lambert 5ST1	118	19°28′32.605″ S	116° 28′ 45.030″ E	WA-16-L
Goodwyn-6	126	19°43′19.078″S	115°51′16.964″E	WA-5-L
Angel-1	91	19°30′14.901″S	116°35′52.544″E	WA-3-L

*ETA wells are managed as per WOMP requirements. Woodside is conducting a detailed review of the subsurface and well barrier status to determine adequacy as permanent barriers.

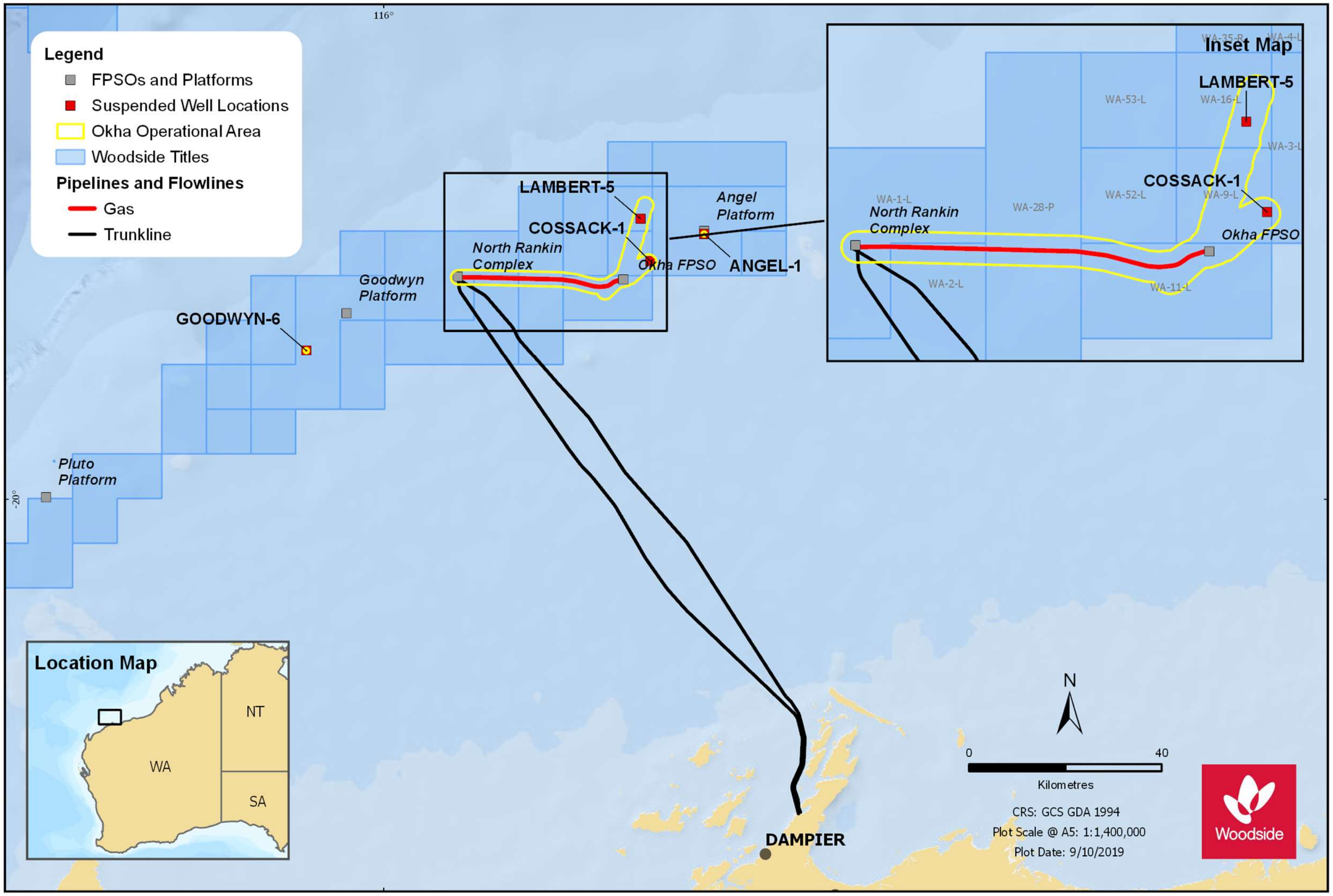

Figure 3-1: Okha FPSO and Operational Area

3.3 Operational Area

The Operational Area applicable to the scope of this EP is shown in Figure 3-1 and includes:

- the Okha FPSO and the area around the facility extending out to 1500 m to allow for offtake activities (including the 500 m PSZ)
- the Okha FPSO subsea infrastructure, including wells and flowlines, and an area 1500 m from the infrastructure
- the temporary abandoned exploration wells (Lambert 5ST1, Cossack-1, Goodwyn-6 and Angel-1) and an area of 500 m around each well
- the WC GEL ending at the outboard flange of NRA pipeline end module, and an area within 1500 m of the infrastructure.

Vessel-related activities within the Operational Area will comply with this EP. Vessels supporting the Petroleum Activities Program when outside the Operational Area must adhere to applicable maritime regulations and other requirements. This EP applies to activities undertaken within the Operational Area, as described in this section.

3.4 Timing

The Okha FPSO commenced production in September 2011. From 1995 to September 2011, the CWLH oil fields were produced through the Cossack Pioneer FPSO. The Okha FPSO operates 24 hours a day, 365 days a year. Supporting operations, such as maintenance activities, take place as required.

The CWLH fields are predicted to remain active during the life of this EP. Tie-back opportunities, which have the potential to extend the life of the field, are continuously being reviewed for Woodside’s offshore facilities.

3.5 Facility Layout and Description

This section summarises the Okha FPSO and associated infrastructure, as relevant to consideration of the environmental risks and impacts of the Petroleum Activities Program.

3.5.1 Topsides

The Okha FPSO is a converted double-hull tanker, 318 m long and 48 m wide. The topsides processing facilities comprise oil, water, and gas separation systems, well service pumping, gas compression equipment, gas dehydration, fuel gas, flare, and other utility systems (Section 3.6.8).

The process and utility equipment on the topsides comprises 11 pre-assembled units (PAUs), which are elevated above the FPSO deck and have a plated lower deck and grated upper decks. Each PAU has its own primary structure, equipment, and associated piping, valves, and instrumentation. Process equipment is located as far as possible from the accommodation facilities, the primary Temporary Refuge, and the Central Control Room (CCR), all of which are at the stern of the vessel. A number of laydown and supplies handling and storage areas are also provided.

The PAUs (see Figure 3-2 for locations) are:

- M01: Separation
- M03: Export Gas and Compression
- M05: Gas Lift Compression
- M06: Flare Knock Out (KO) Drum
- M07: Gas Processing

- M08: Portside Laydown / Chemicals
- M11: Power Generation and Utilities
- M12: Power Generation
- M13: Local Equipment
- M20: Pipe Rack
- M25: Flare Stack.

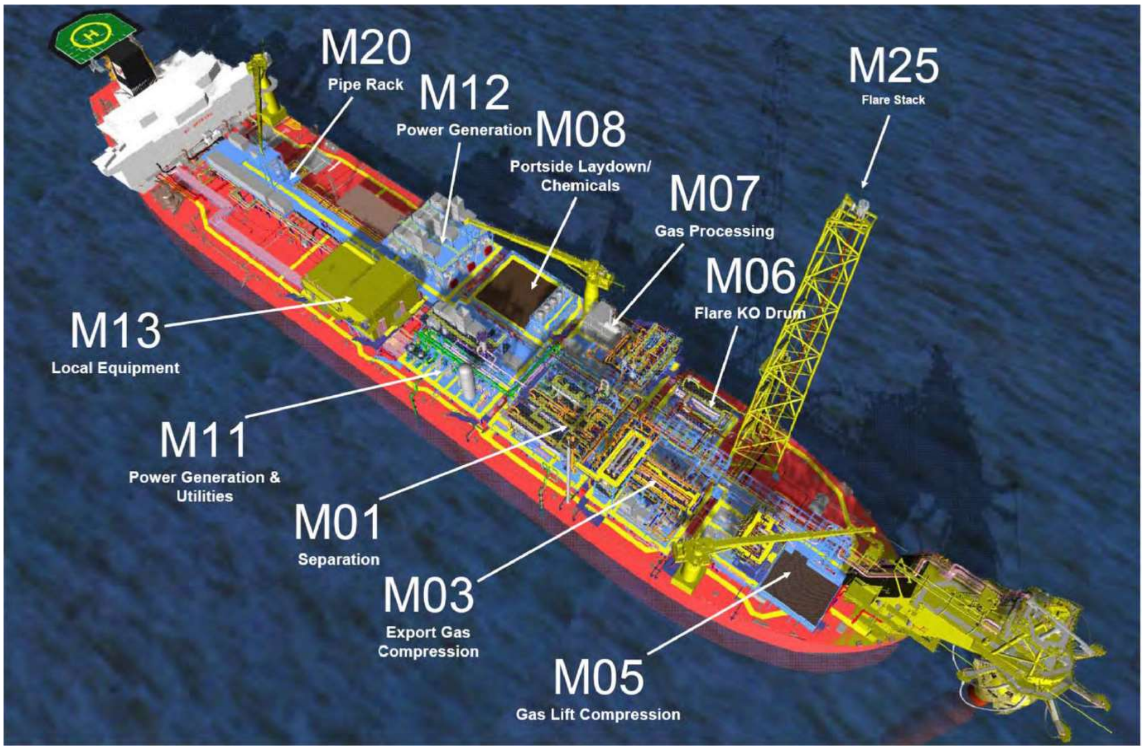

Figure 3-2: Okha FPSO topsides layout

3.5.2 Wells and Reservoirs

Subsea production wells and PTA wells referred to in Table 3-1, are tied back to the Okha FPSO via five production manifolds. Table 3-2 lists the wells for the CWLH reservoir fields.

Table 3-2: Reservoir fields and their wells

Reservoir Field	# of Wells	Well Names
Cossack	1	CK4
Lambert	2	LA4, LA7
Hermes	2	LH3, LH6
Wanaea	8	WA1, WA2, WA3, WA11, WA6, WA7, WA8, WA9

The CWLH fields contain light crude oil with varying gas-to-oil ratios. The oil from the Wanaea reservoir has a relatively high gas-to-oil ratio, while the Cossack, Lambert, and Hermes reservoirs do not contain as many light components.

All producing wells use gas lift to optimise production. Gas lift is supplied from the Okha FPSO and is distributed to individual wells via flowlines interconnecting the gas lift integrated manifold, the gas lift inline skid, and the gas lift end skid.

The Okha FPSO facility's Integrated Control and Safety System (ICSS) monitors all subsea Xmas tree instrumentation and operates subsea tree valves via the subsea control system. A surface controlled subsurface safety valve (SCSSV) is installed ~150 m below the seabed on each well as the downhole well barrier. These valves are designed fail safe to automatically close upon a loss of hydraulic pressure.

3.5.2.1 Temporary Abandoned Wells

There are ETA wells and PTA wells that fall within the scope of this EP (Table 3-1). The wells are managed under accepted Well Operations Management Plans (WOMP). The wells are maintained as per a set IMMR activity schedule until they are permanently plugged for abandonment (subject to a separate EP). The integrity of all abandoned wells is assessed prior to abandonment and the abandoned wells are monitored and inspected based on the assessed risk.

All PTA wells with the exception of WA2 remain connected to the facility with associated subsea infrastructure. Production of hydrocarbons from these wells has ceased however the wells are still subject to performance standard P10 requirements including ongoing annual integrity assessments until permanently plugged and abandoned.

ETA wells are not tied back to the Okha FPSO and have no associated infrastructure (i.e. Xmas tree). As per commitments in the accepted Okha WOMP, Woodside has embarked on a plug and abandonment project, which defines the time to permanently abandon each PTA or ETA well (or set of wells). Permanent plugging and abandonment activities will be subject to a separate EP.

3.5.3 Subsea Infrastructure

The main components of subsea infrastructure include wells, wellheads, Xmas trees, manifolds, spools, flowlines, jumpers, umbilicals, risers and the gas export riser, flowline and WC GEL. The layout of the Okha FPSO subsea infrastructure is shown in Figure 3-3.

The subsea system is typically controlled from the Okha FPSO via ICSS through these components:

- umbilicals, which provide hydraulic control, electric power and chemical injection from the FPSO and subsea components. Umbilicals run between the FPSO and manifolds and electrohydraulic jumpers run from manifolds to Xmas trees
- valves and chokes to control subsea operations and processes
- subsea control modules (SCMs), which are sealed and pressure-compensated electrohydraulic units (typically found on the manifolds and/or Xmas trees) and link the surface and subsea systems.

A number of subsea valves may be overridden manually by divers, or from a remotely operated vehicle (ROV).

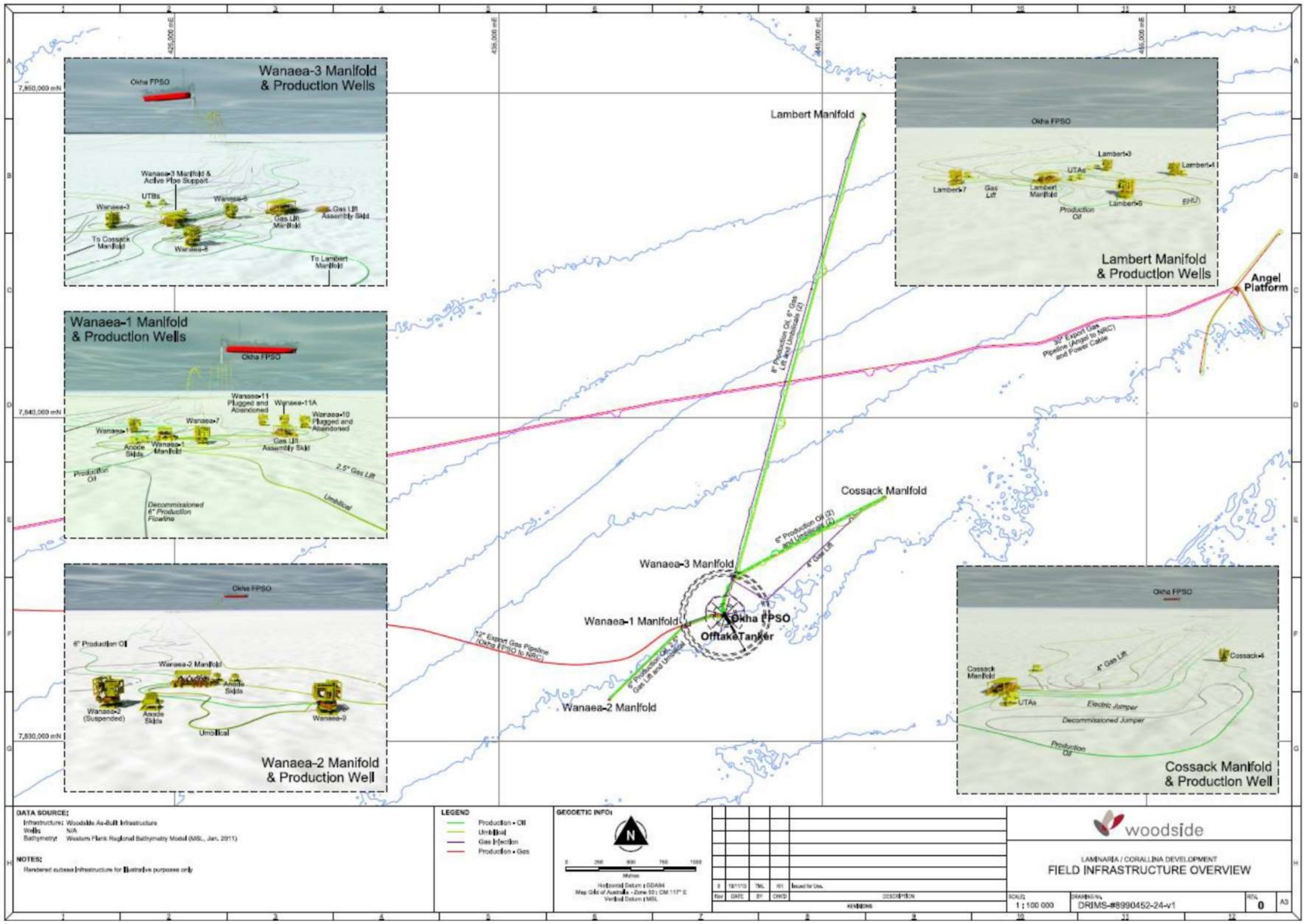

Figure 3-3: Okha FPSO subsea infrastructure

3.5.4 Gas Export Line System

Gas is exported from Okha FPSO via a 197 m riser and a 420 m flexible flowline that transports gas to the WC GEL pipeline. WC GEL is 12 inches in diameter and transports gas from the Okha FPSO to either trunklines and onshore to the KGP. The WC GEL route begins downstream of the Okha gas export riser emergency shutdown valve (RESDV) and runs 32 km westwards to the outboard flange of the NRA pipeline end module adjacent to the NRC.

3.5.5 Riser Turret Mooring System

The Okha FPSO is moored over the central area of the Wanaea field, via a rigid arm to a riser turret that is anchored to the seabed with eight anchor chains and associated gravity-based anchors. The mooring configuration is shown in Figure 3-4.

The primary functions of the RTM are to:

- moor the Okha FPSO on station and allow the vessel to freely weathervane
- allow connection to / disconnection from the riser column if weather conditions exceed the design limits of the connected system, or planned remedial or modification works are undertaken
- support the flexible risers and the mooring chains in both connected and disconnected modes
- provide fluid transfer and control system communication between the Okha FPSO and subsea infrastructure.

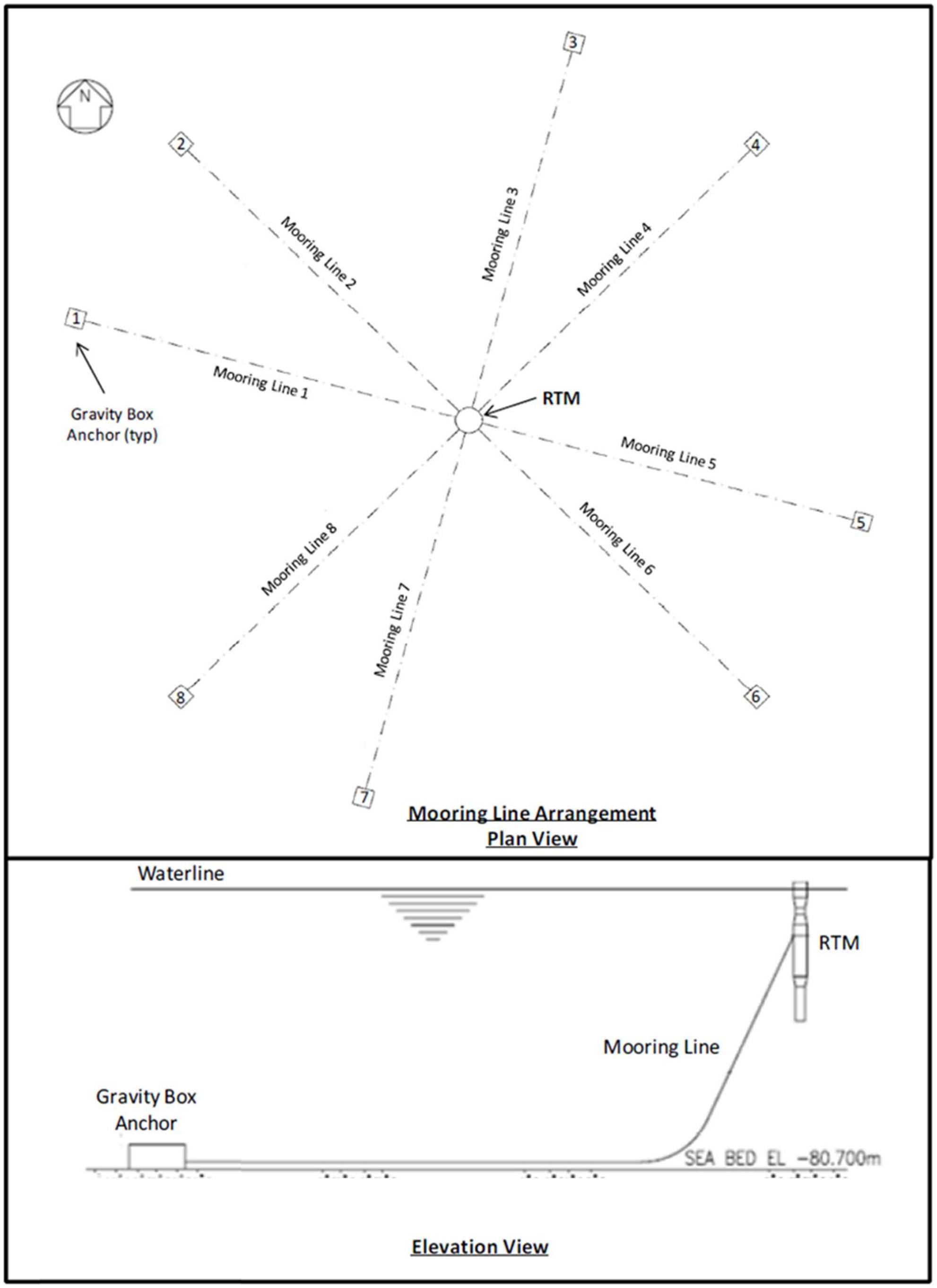

Figure 3-4: Okha FPSO mooring configuration

3.5.6 Disconnection and Reconnection of FPSO from the Mooring and Riser Column

Disconnecting and reconnecting the Okha FPSO from the riser column buoy is conducted in accordance with specific procedures. In preparation for disconnection, production is shut down, and the topsides, risers, and flowlines are depressurised via the flare system. The risers are depressurised to a nominated safe pressure before closing the RESDVs and isolation valves. Before being disconnected, the piping within the column and swivel are drained, flushed, and purged.

Disconnection is achieved by disengaging the structural connector that links the universal joint to the top of the riser column. Upon disconnection, the riser column drops down from the rigid arm on the Okha FPSO and remains afloat. Once disconnected, the Okha FPSO operates as a seagoing vessel and complies with regulatory maritime requirements.

Reconnecting the two hubs of the structural connector is done by lifting the riser column with a heavy steel wire rope, which passes through the centre of a hollow steel guide piece incorporated in the structural connector body. This piece provides a centring function when it engages; in the final lifting phase, the two connector hubs are guided into contact.

3.6 Operational Details

This section describes the main operations associated with the Okha FPSO. It includes key elements relating to interactions between the activity and the environment, as described further in these sections:

- Manning and Modes of Operation (Section 3.6.1)
- Process Description (Section 3.6.2)
- Facility Utility Systems (Section 3.6.8)
- Facility Operations (Section 3.6.9)
- Hydrocarbon and Chemical Inventories and Selection (Section 3.9)
- Subsea Inspection, Monitoring, Maintenance, and Repair (IMMR) Activities (Section 3.10)

3.6.1 Modes of Operation

Normal operations at the Okha FPSO fall under any one of these main modes of operation, some of which may occur concurrently:

- production and maintenance, including subsea IMMR activities (Section 3.6.1.1)
- major projects involving refurbishment, modification, or major maintenance on the facility (Section 3.6.1.2)
- FPSO marine (disconnected) mode (Section 3.6.1.3).

The CCR is staffed 24/7 for all modes of operation.

3.6.1.1 Production and Maintenance

Production and maintenance covers hydrocarbon receipt, processing, storage for offtake, offtake to export tankers and supporting operations. IMMR activities are undertaken concurrently to maintain production within the Okha FPSO design constraints.

3.6.1.2 Major Projects

Major projects involve refurbishing, modifying, or undertaking major maintenance on the facility. Major maintenance or project work is normally completed outside the operational area.

3.6.1.3 FPSO Marine (Disconnected) Mode

The Okha FPSO can operate as a self-propelled vessel to avoid adverse weather conditions or for remedial maintenance or modifications at a shipyard. Once disconnected from the RTM, the Okha FPSO complies with all applicable maritime regulations. The Okha FPSO is not covered by this EP when it is operating in marine mode (i.e. disconnected) outside the Operational Area.

The Okha FPSO is maintained with sufficient personnel and in a condition such that it is prepared to disconnect at all times. Criteria for disconnecting from the mooring resulting from adverse weather include considering the predicted wind speed, currents, and wave heights, and comparing these to the vessel's operational limits and its anticipated pitch, roll, heave, and draft.

3.6.2 Process Description

The Okha FPSO receives well fluids (crude oil, gas, and associated produced water [PW]) from the production wells for topside processing, which includes:

- separating gas, crude oil, and water
- compressing and exporting gas
- treating and disposing of PW.

The Okha FPSO directly exports processed crude oil by offtake to offtake tankers. The facility is designed to process 60,000 bbl/d of oil and 100,000 bbl/d of water, and the gas compression trains can produce up to 82 MMscfd of export gas and up to 60 MMscfd of lift gas. The first processing stage is separating the well fluids in the HP and test separators. Fluids are then further separated in the low-pressure (LP) separator, and the crude is subsequently cooled and discharged into the FPSO oil storage tanks. Gas evolved from the LP separator is fed to the cargo tanks to provide gas blanketing, and to the flash gas compression system.

Figure 3-5 is a schematic diagram of the Okha FPSO process, which is described in more detail in the subsections below.

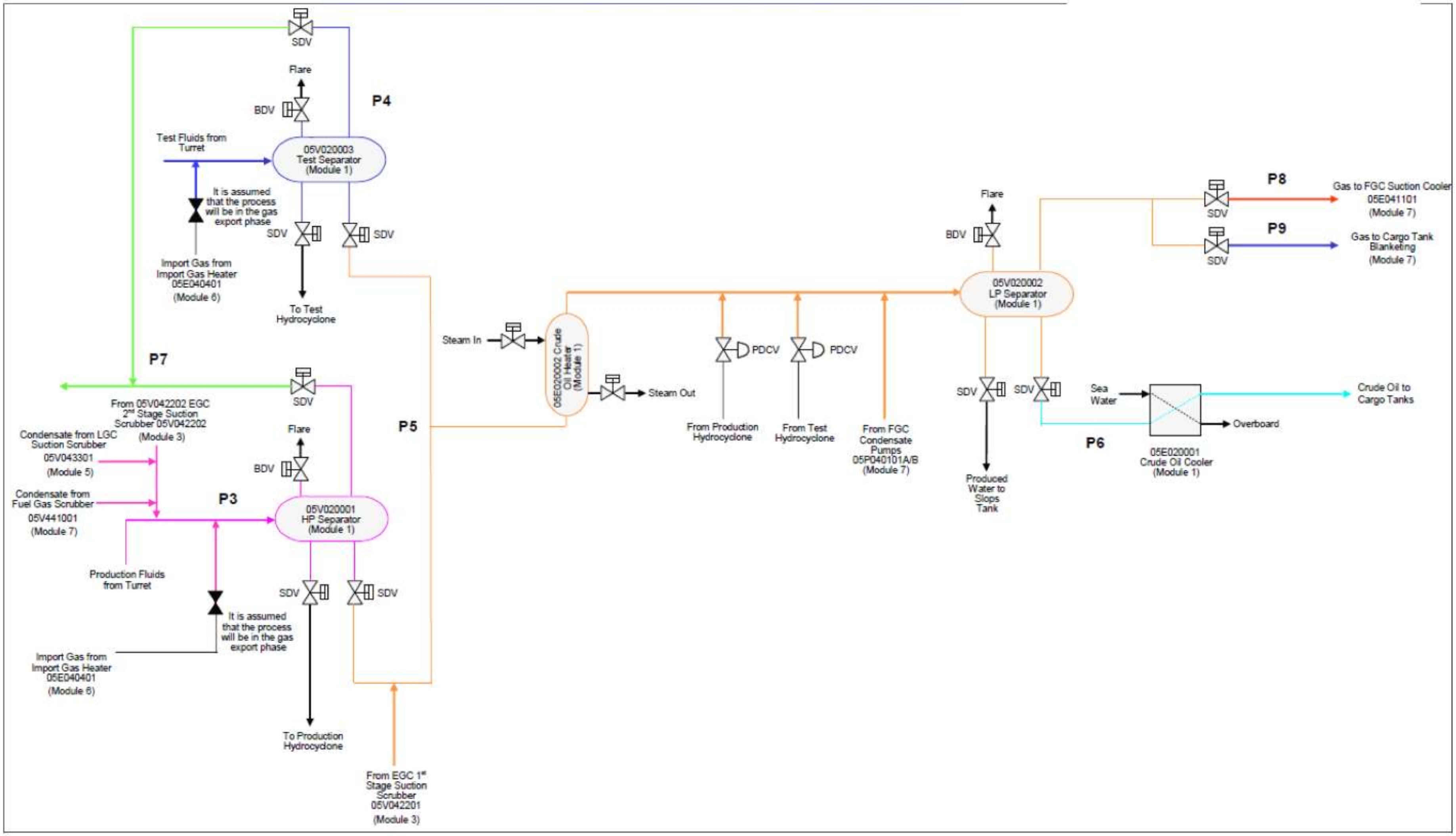

Figure 3-5: Okha FPSO process flow diagram

3.6.2.1 Flare Systems

The Okha FPSO is equipped with a normally closed flare system, comprising HP and LP headers. Flare headers safely collect and remove vapours and liquids venting from the topside module pressure safety valves, blowdown valves, flare relief pressure control valves, and manual vents.

Flare scrubbers collect liquid that may be vented to the flare headers (or have condensed in the flare headers) to prevent burning liquids exiting the flare tips. Flare stacks exit the flare scrubbers and terminate at separate flare tips. The flare tips are closely aligned and are ignited by a flare ignition package. The HP and LP flare towers are at the bow of the Okha FPSO and are ~82 m high above deck and ~98 m above sea level.

Normal Operations

During normal operations, no continuous flaring (including flare purge/pilot) will occur due to the closed-loop design flare system. HP flare purge gas is recovered via the flash gas compressor and LP flare header purge gas / cargo tank flash gas is recovered via the vapour recovery unit (VRU). There are no pilot gas supplies to the flare tips as flare ignition is achieved by an ignition pellet launch system. Purging of the flare stack (the piping from the flare drum outlet isolation valves) to the flare tips is achieved via a nitrogen gas supply. Woodside anticipates that no gas will be continuously flared during normal operations, based on system design and operational experience. If there is a gas release to flare that cannot be accommodated by the recovery system, flow to that recovery system will stop and will be redirected to the respective flare. The flow of gas through each of the HP and LP flare systems is measured using separate flow meters.

Intermittent Process Upsets and Activities

During process upsets, the process control valves on the main process equipment will open to relieve excess pressure to the HP flare. The HP flare tip allows continuous flaring at the full gas production of 90 MMscfd (125,000 kg/hour) and an emergency rate of 133 MMscfd (185,000 kg/hour). The LP flare tip allows continuous flaring at the full gas production rate of 16 MMscfd (38,000 kg/hour) and an emergency rate of 23.5 MMscfd (49,0000 kg/hour).

Emergency Flaring

After an emergency trip of the topsides, the HP inventory in the topsides piping, trains and equipment will be sent to flare to safely remove all HP gas sources and depressurise topsides equipment. The topsides equipment and piping is divided into isolatable sections, each with a dedicated blowdown valve (BDV). During an emergency shutdown, each section is separately depressurised to the HP or LP flare. Each section contains a fail open actuated BDV, which allows blowdown of the entire facility inventory.

Manual Depressurisation

Manual depressurisations will result in intermittent flaring of hydrocarbons, triggered by routine equipment maintenance, planned emergency shutdown testing and/or depressurising equipment and piping to remove the equipment from service. Equipment must be depressurised before draining because the drains system is not intended for HP service.

Subsea Flowline Depressurisation

On rare occasions, the fluid in the subsea flowlines/pipelines (which carry hydrocarbons from the subsea wells to the Okha FPSO) may need to be routed to the flare system to reduce pressure in the flowlines. The flowlines may need to be depressurised for these reasons:

- production flowline maintenance and critical leak-off testing
- to facilitate remediation if an unplanned hydrate blockage occurs in the subsea flowlines

- manage flowline integrity limit
- suspend redundant pipelines/flowlines.

3.6.3 Produced Water System

Produced water (PW) can comprise produced formation water (a water reservoir below the hydrocarbon formation), condensed water (water vapour present within gas/condensate that condenses when brought to the surface), or both. PW is separated out from the hydrocarbon components during the production process and discharged to the marine environment. PW is discharged via a caisson from the side of the ship between 4 m and 12 m below lowest astronomical tide (LAT) (the exact depth varies with ballast/loading) or via the slops tank at surface.

The Okha FPSO has been designed to process 18,000 m^3 of PW per day; however, discharge rates are typically much lower—in 2018, the Okha FPSO discharged 6,350 m^3 per day. Overall, Woodside expects that PW rates will increase as the CWLH fields age.

3.6.3.1 PW System Description

The PW system on the Okha FPSO comprises lines that connect the process to the HP separators, the PW hydrocyclones, and the LP separator (Figure 3-6).

The PW stream primarily comprises:

- water recovered from the well fluid stream by the HP separators or test separators that has been treated by the PW hydrocyclones
- PW diverted from the LP separator to the slops tank for first-stage gravity settling.

The Okha FPSO PW system:

- cleans the separated PW of oil and particulate contaminants
- cools and de-gasses the PW.

PW that is separated out in the HP and test separators is routed under level control to three hydrocyclones to remove any residual oil droplets and particulates.

De-oiled water from these hydrocyclones is sent to the PW flash drum. Reject oily water is fed to the LP separator. The flash drum has a hydrocarbon skimming facility to remove any residual oil that collects in the vessel. Skimmed oil is routed to the slops tanks. Separated gas from the flash drum is sent to the vapour recovery unit (VRU) via the LP flare.

An online analyser monitors the oil-in-water (OIW) content:

- if the OIW content is within specification, the PW is discharged directly overboard
- if the OIW content is off specification, the PW is automatically diverted to the slops tank for further treatment (separation) before being discharged in accordance with the EP requirements.

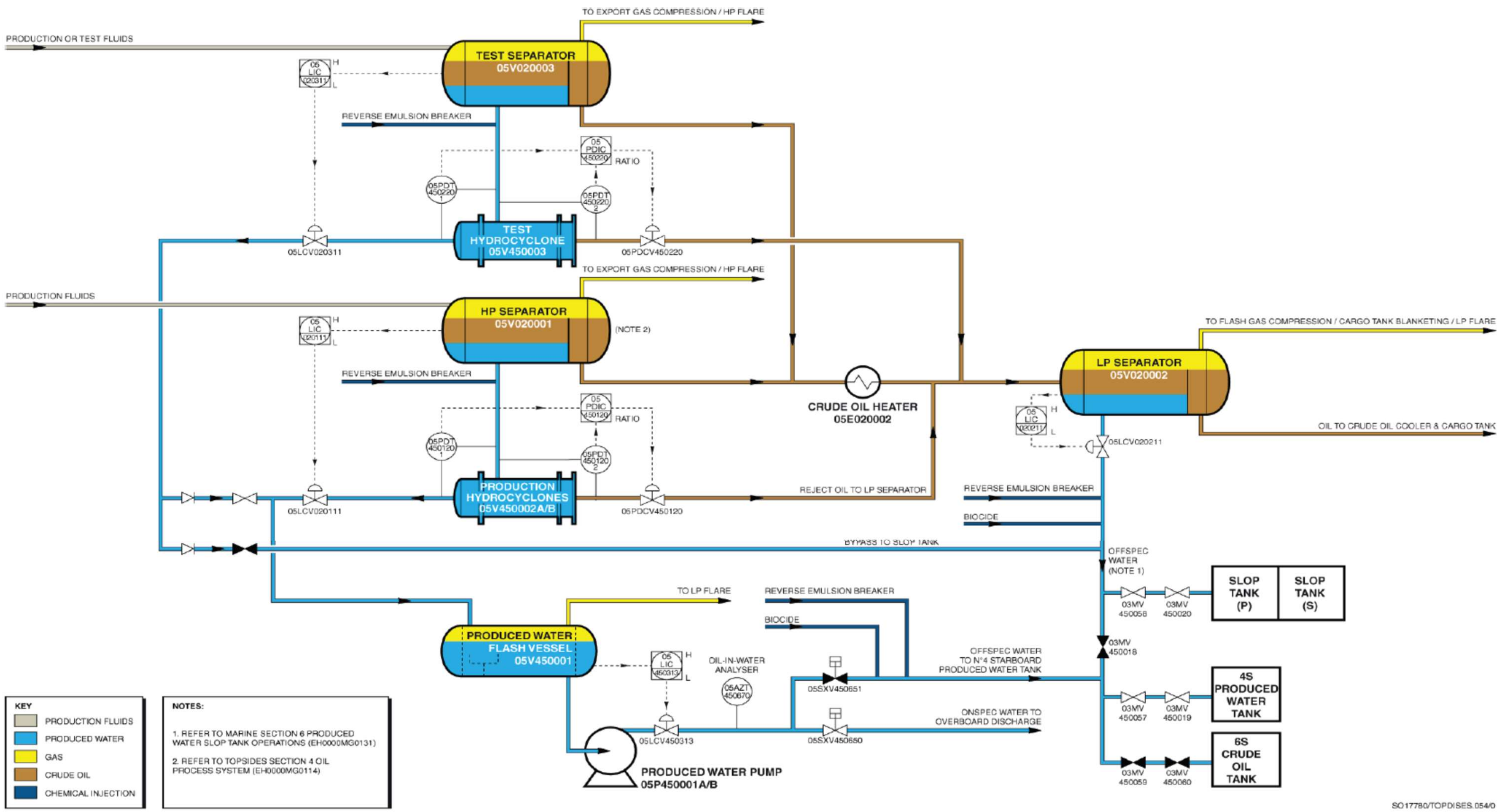

Figure 3-6: Okha produced water system overview

3.6.4 Drainage Systems

The Okha FPSO topsides / RTM has three drainage systems (see Figure 3-7):

- Non-hazardous open drain: Collects drain fluids (e.g. rain water) from non-hazardous areas and disposes of them to the slops tanks, or overboard in case of a major deluge of fire water or rain water.
- Hazardous open drain: Collects drain fluids (e.g. oil-contaminated water) from hazardous areas and routes them to the slop tanks; includes the drain lines from the different levels of the RTM. The oily water in the slops tanks is separated by gravity and after settling is discharged in accordance with legislative requirements. There is provision to chemically treat slops water and/or transfer to different tanks if required. Oil recovered in the slops tank is routed to the cargo storage tank.
- Maintenance drain: Four drains help remove large volumes of hydrocarbon vapour and liquids (used for maintenance purposes), from the compressor scrubbers and separators. These drains directly tie into the cargo tank header, and from there—depending on operational requirements—hydrocarbons are directed to the applicable cargo tank.

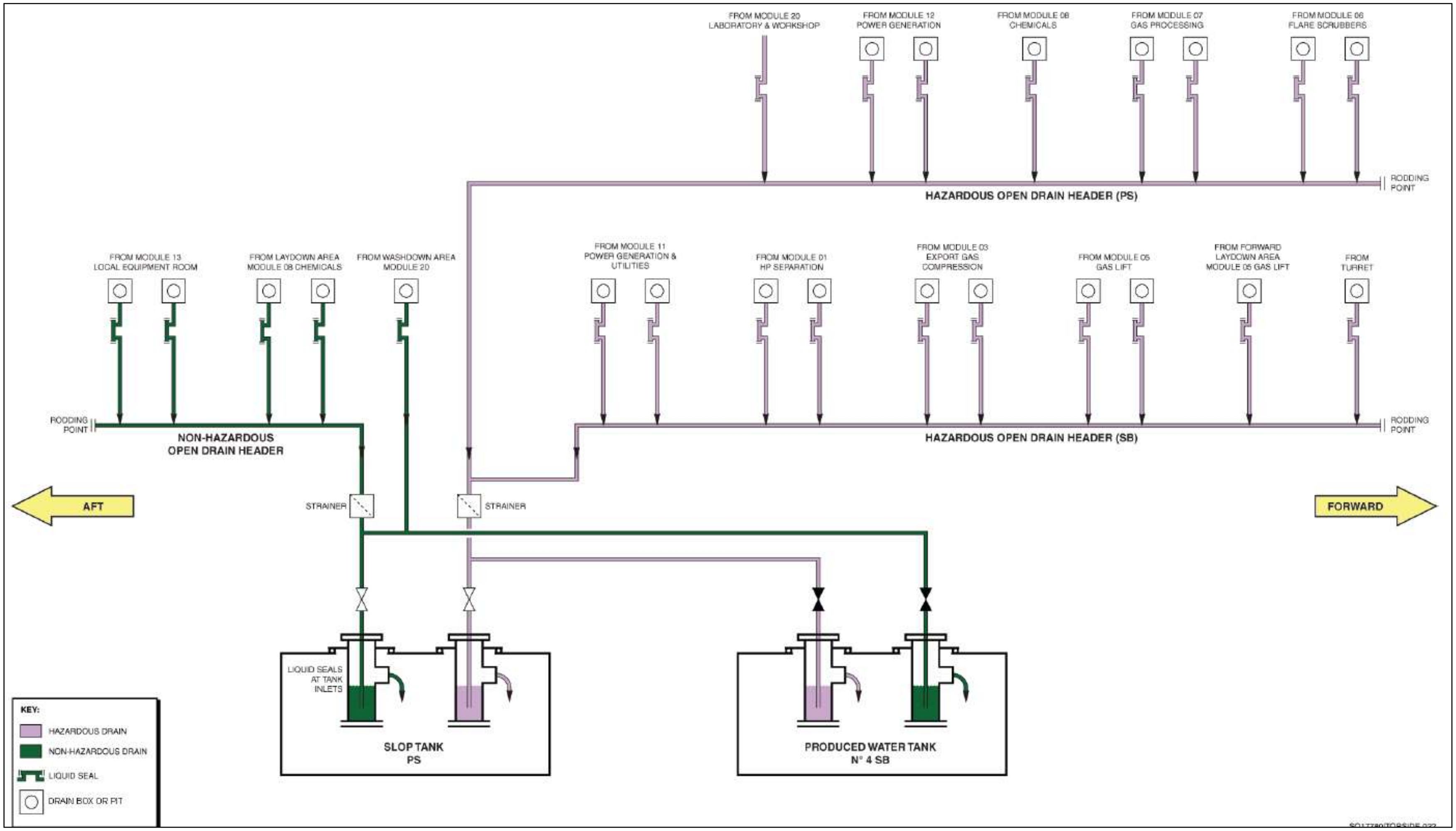

Figure 3-7: Okha FPSO hazardous and non-hazardous drains system

3.6.5 Cargo Tanks

The Okha FPSO has 11 dedicated cargo tanks that are designed to receive and store crude oil directly from the topside process plant. The crude oil is fed from the topsides directly to the cargo tank by dedicated drop lines into the top of each cargo tank. The individual storage tanks vary in capacity, with a total operational storage capacity of 934,000 bbl of oil.

Three cargo pumps in the cargo pump room are used to transfer the crude oil to offtake tankers and redistribute crude oil around the cargo tanks. The pump valves are hydraulically operated from the CCR. During cargo export, two cargo pumps are available to achieve the required maximum offtake rate of 4000 m^3/hour.

The Okha FPSO is designed to load and discharge concurrently while maintaining double-valve segregation between incoming and exported crude oil and between crude and PW systems. Cargo loading and discharge is controlled from the CCR.

3.6.6 Offtake System and Offtake Tanker Mooring

Offtake operations from the Okha FPSO happen about every three weeks. The Okha FPSO has a tandem offtake system, which provides handling facilities to non-dedicated tankers up to 150,000 T. Steam-driven pumps are used to pump offtake crude oil to the offtake tanker via cargo piping that leads to a 20-inch diameter floating hose. This hose is stored on a reel at the stern of the Okha FPSO when not in use to reduce the likelihood of hose damage during handling or impact by vessel. The hose is made of heavily reinforced material in sections ~10 m long and has flanged and bolted connections between sections; this allows each section to be independently tested and replaced if necessary. A double dry break coupling, which releases automatically at a pre-set tension, is fitted ~15 m from the offtake rail end of the hose.

3.6.7 Ballast System

The Okha FPSO seawater ballast system is used to counteract shear force and bending movement stresses on the FPSO’s hull caused by loading and offtake crude oil in the vessel’s storage tanks. Ballasting also controls the trim and heel of the vessel to ensure stability remains within the design limits.

Segregated ballast is carried in the fore and aft peak tanks of the FPSO, and in six pairs of wing tanks arranged the entire length of the cargo tank area. The total capacity of the segregated ballast tanks is ~51,600 m^3. All ballast pumps are interconnected to allow flexible operation.

Ballast tanks are filled and discharged by ballast water pumps or gravity until the water level in the tank equalises with the draft level of the Okha FPSO.

The volumes of the main ballast tanks are controlled by two centrifugal pumps, which are located in the pump room and have their own sea chest. The pumps are connected to an overboard discharge line that ends ~0.5 m above the deepest water ballast line on the port side.

3.6.8 Facility Utility Systems

3.6.8.1 Facility FPSO Lighting

Okha FPSO lighting is split between emergency and normal lighting. Battery-backed emergency light fittings illuminate designated escape routes.

Navigational lights are on the Okha FPSO flare tower and on the crane booms and tower. Helideck lighting assists helicopter landing. Unless required to support over-the-side activities (such as refuelling and lifting operations), lighting on the Okha FPSO is directed to the work area, which helps limit light to sea.

3.6.8.2 Heating Ventilation and Air Conditioning

The heating, ventilation, and air conditioning (HVAC) system comprises HVAC equipment, ductwork, and associated pipework. It provides independent and inter-dependent subsystems with pressurised, conditioned, purged, and exhaust air services to various areas, including accommodation and various modules. Various parts of the HVAC system can be operated on an ‘as required’ or continuous basis.

Mechanical exhaust systems supplement ventilation and HVAC systems, fume extraction systems, and are used in any negatively pressurised areas. Ozone-depleting substances are no longer used on the Okha FPSO and refrigerants associated with the HVAC system are managed by a licensed refrigerant authority.

3.6.8.3 Steam System

Two auxiliary boilers provide steam to the Okha FPSO steam distribution system. They are configured for dual-fuel operation using gas and diesel or steam for atomising diesel. One boiler is sufficient to meet the steam requirements during normal production and utilities operating mode. However, during cargo offtake when two cargo pumps are in operation, both boilers operate in parallel to meet the increased steam demand.

3.6.8.4 Cooling and Freshwater Treatment Systems

Seawater System

The topsides seawater system provides seawater cooling to the central coolers (heat exchangers) where the cooling medium system transfers the waste heat from the machinery and utilities to the sea water. Sea water dosed with biocide may be injected into the subsea production system for periods of extended flow line shut-in to prevent sulfur-generating bacteria and thus the build-up of hydrogen sulfide in the subsea system. The sea water will be sent via the well services pump and production and test headers to the subsea flowline. Oxygen scavenger can also be injected into this flow stream. Two lift pumps discharge sea water via coarse filter screens overboard at a disposal temperature of ~20 °C above ambient sea water temperature, with the third pump on standby. Maximum discharge rate of the system is 2670 m^3/hour. Each pump is submerged in a dedicated suction caisson. Hypochlorite from the hypochlorite generator package is injected into the seawater suction systems to prevent marine growth.

Other continuous sea water systems (both part of the hull seawater system) that continuously discharge sea water include:

- two air conditioning cooling water pumps are used to supply cooling sea water to the air conditioning condenser before discharging overboard at a maximum flow rate of 390 m^3/hour. Either pump can be selected as duty or standby.
- three seawater cooling pumps that are configured as required to supply cooling water to the low temperature freshwater coolers in the engine room of the FPSO. Maximum discharge rate of each pump is 400 m^3/hour.

Based on the continuously discharging cooling water systems described above and other intermittent cooling systems, the typical volume of cooling water discharged is 57,000 m^3/day. The maximum potentially discharged volume is 102,240 m^3/day based on the integrity limit of the equipment.

Topsides Cooling Medium System

The topsides cooling medium water system on the Okha FPSO provides indirect cooling by recirculating chemically treated distilled water through a closed-loop system to remove heat from process and utility coolers. Cooling medium is circulated around the system by the cooling medium circulation pumps. The cooling medium pumps take suction from the cooling medium expansion vessel, which is located at the system high point. From the pumps, cooling medium is fed to the plate heat exchangers where it is cooled by the seawater system. From these exchangers the cooling medium is distributed to all users.

To prevent general corrosion, fouling, and blocking small passages in the heat exchangers, the cooling medium system is dosed as required with oxygen scavenger, pH buffer, and biocide. Periodic system maintenance may require the sections in the cooling medium system to be drained, resulting in the discharge of water and residual treatment chemicals to the marine environment.

Marine Freshwater System (Hull System)

The freshwater cooling system (closed-loop) comprises two separate systems: a high temperature (HT) and a low temperature (LT) cooling freshwater system. Cooling medium used in both the LT and HT cooling systems is a solution of fresh water and chemical corrosion inhibitor. The HT cooling water system provides cooling water to the main engine water jacket and heating water for the No. 1 and 2 freshwater generators. The LT cooling water system provides cooling to the bulk of the FPSO's engine room machinery, including the cold water side of the main engine jacket freshwater cooler and the auxiliary engines' cooling water jackets.

Potable Water

The three freshwater generators provide water to the potable water tank and the distilled water tank. The system is designed to provide an adequate supply of boiler water plus a daily fresh water supply rated at 20 m^3/day. Approximately 60 m^3/day of brine is discharged (20 m^3 per generator) as a result of this process.

A hydrophore system with pressurised tanks, pumps, filters, sterilisers, and a calorifier provide the potable water distribution system for the accommodation facilities with a pressurised hot and cold water supply. Fresh water can also be bunkered into the storage tanks using the freshwater bunker filling hose located at the upper deck supply boat landing area.

3.6.8.5 Hydrocarbon Blanketing and Inert Gas System

The Okha FPSO uses hydrocarbon gas as the primary medium for topping up and inerting the cargo tanks during loading, storage, production, and offtake operations. The system is designed to eliminate the emission of cargo tank vapours, which would conventionally be cold vented through the cargo tank vents. The system prevents an explosive atmosphere in the cargo tanks by excluding air (oxygen) from the tanks and maintaining a 100% hydrocarbon blanket in the vapour space of the tanks.

Hydrocarbon gas is produced by the LP separator on topsides and distributed to the cargo tanks via a dedicated header and associated tank branches. Hydrocarbon gas is also produced by the crude oil boiling off inside the cargo tanks. This gas is recovered by the VRU, which manages the tank pressures during normal operations.

Inert gas is produced on the Okha FPSO by the auxiliary gas-/diesel-fired boilers. If the hydrocarbon gas blanketing supply is unavailable for any reason (e.g. an oil process system trip, tank entry activity, purging of cargo tanks of air prior to loading with oil, sailing mode or riser disconnection), the inert gas system is brought on line to preserve the inert gas blanket in the cargo tanks until the hydrocarbon gas blanketing system can be reinstated.

3.6.8.6 Power Generation

The main power generation for the Okha FPSO is supplied by four 12.5 MVA gas turbine driven generators. The entire Okha FPSO can consume 21 MW of power for normal operating conditions, which includes offtake operations. This power is normally supplied by two online gas turbines, with the remaining two as spare or out of service for maintenance.

The turbines operate on fuel gas during normal operations, but can run on diesel during process upsets, facility start-up, or when bringing a turbine back into service after maintenance. When the facility is off station in sailing mode, power generation is supplied by the three 900 kW diesel generators located in the engine room.

Emergency power is supplied by a single 880 kW emergency black-start diesel generator. This emergency generator supplies power to the Okha FPSO's emergency switchboard, which then provides power to auxiliary equipment such as pre-lube and starting air supply for the essential generators. The emergency generator starts automatically if mains power is lost. Two independent uninterrupted power supply (UPS) systems, which are physically separated from each other, provide redundant temporary power supplies for SCQ regardless of the state of emergency (essential or main generation).

3.6.8.7 Fuel Gas System

The fuel gas system supplies superheated fuel gas at two pressure levels. HP fuel gas is only required for the power generator gas turbines. The consumers of LP fuel gas are the marine boilers, HP and LP flare header purge, triethylene glycol (TEG) regeneration package, and PW flash vessel gas outlet purge.

Total fuel gas consumption on the Okha FPSO is metered by a fuel gas flow transmitter. The average power consumption from maximum topsides power demand and others is ~108,250 sm^3/day and is expected to be relatively constant throughout field life.

3.6.8.8 Safety Features and Emergency Systems

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

3.6.8.9 Sewage and Putrescible Wastes

Sewage from the ablution areas is macerated and disposed of to the ocean via the hull discharge line (below the water line).

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

3.6.9 Facility Operations

3.6.9.1 Lifting Operations

The Okha FPSO has four rotating pedestal cranes and one overhead crane, as well as numerous local handling/lifting equipment. Dedicated laydown areas (Figure 3-8) for materials, chemicals, and provisions are located to optimise lifting/handling and reduce manual handling. The subsections below give further details on the types of lifting activities and cranes used.

Routine Lifting from Facility Support Vessels

Routine lifting operations primarily include transferring stores and equipment from a support vessel to the main or stores laydown areas. Support vessels are equipped with dynamic positioning system (DP) for holding station during lifting operations. The types of lifted equipment varies, but generally include containers or skips of various sizes. Supply of chemicals are also routinely lifted, with the largest volume of transfer via container ~3.8m^3.

After offloading from the supply vessel is complete, the FPSO backloads to the supply boat any items to be returned to shore (e.g. empty containers or skips containing waste for onshore disposal).

Lifting around the Facility

Once lifted to the laydown areas, repositioning to other locations may be required for stores, equipment, ISO containers, or waste bins. Occasionally, a non-routine piece of equipment may need to be lifted, in which case it is packed into a container or an approved lifting frame.

Operational Lifting (non-crane based)

Operational lifting may also require rigging, chain blocks, or electric hoists to be used. This lifting is primarily undertaken for maintenance or repairs and involves lifting and removing equipment such as valves, spools, or motors.

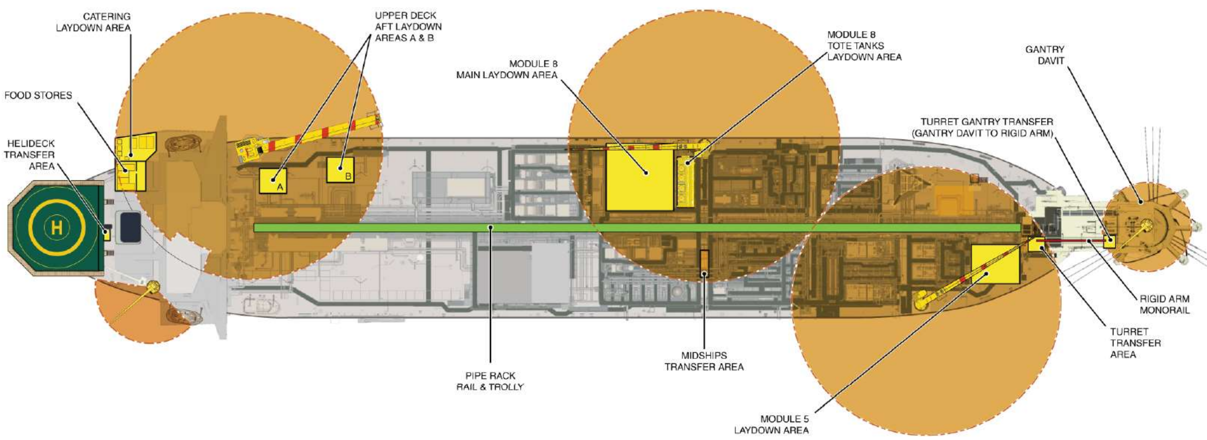

Figure 3-8: Okha FPSO main laydown areas

3.7 Vessels

3.7.1 Support Vessel Operations

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

3.7.1.1 Facility Support Vessel

Various facility support vessels are used (depending on schedules and availability) to transfer material and equipment to and from the Okha FPSO. The specifications for the *Siem Thiima*—a typical support vessel—are listed in Table 3-3.

The *Siem Thiima* is the first LNG-powered vessel. Carbon emissions of LNG are up to 25% lower than diesel and 30% lower than heavy fuel, and this vessel emits almost no sulfur or particulates.

The current schedule is for a vessel to visit the facility fortnightly for supply activities, and as required for offtake support. While in the field, the vessel also backloads materials and segregated waste for transport to the King Bay Supply Facility in Karratha and carries out standby duties during activities such as helicopter operations and working over the side, when required.

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

Attribute	Details
Type	Facility support vessel
Length overall	89.2 m

Attribute	Details
Breadth	19.0 m
Draft	7.6 m
Dead weight tonnage	5,500 T
Accommodation	Berthing for 25 personnel
Dynamic positioning system	DP2
Fuel capacity	964 m^3

3.7.1.2 Subsea Support Vessels

Subsea support vessels are used for subsea IMMR activities. Vessels vary depending on operational requirements, vessel schedules, capability, and availability.

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

3.8 Helicopter Operations

Helicopters are the primary means of transporting people and/or urgent freight to and from the Okha FPSO and are the preferred means of evacuating personnel in an emergency. No helicopter refuelling occurs on the Okha FPSO. Typically, six return trips per fortnight are undertaken; during campaign periods this frequency increases to approximately eight return trips per fortnight.

3.9 Hydrocarbon and Chemical Inventories and Selection

3.9.1 Hydrocarbons

The main bulk hydrocarbon inventories associated with major topsides process equipment are summarised in Table 3-4.

Table 3-4: Hydrocarbon bulk liquid inventories of major process equipment

Vessel	Liquid Volume (m^3)
HP separator	113.5
Test separator	26.3
LP separator	31.2
1st stage export gas compression	4.1
Export gas compressor 1st stage suction scrubber	4.1

3.9.1.1 Marine Diesel System and Bunkering

Diesel is transferred to the Okha FPSO from an supply vessel via a bunker hose reel that is transferred to the supply vessel with the use of the aft crane. The diesel is pumped from the supply vessel through the bunker station located on the port aft area of the main deck, to the bunker tanks located on the aft port and starboard sides of the FPSO.

Supply vessels transfer low-sulfur diesel to the Okha FPSO in bulk. The diesel is purified and held in settling and service tanks before being distributed for use to all on-board diesel-fuelled and -fired equipment. Diesel from the settling tank is transferred via the purifiers to the diesel service tanks, from where (if required) it can be used for the topsides gas turbines, generator engines, and the main engine. Outlet valves from the diesel tanks are fitted with quick-closing valves remotely operated from the FPSO's instant valve activation points.

The turbine-driven generators and boilers have dual-fuel capabilities—fuel gas is their primary fuel, with diesel as a secondary fuel source. In addition, the system supplies diesel to the well service pump for valve equalisation, subsea dehydration, and well services. The system comprises three main interconnected systems—storage and transfer system; purification and service system; and equipment (consumer) supply systems. Diesel usage on the Okha FPSO is monitored and metered.

The storage and transfer system comprises the major components listed in Table 3-6.

Table 3-6: Storage and transfer system major components

Diesel Oil Tank Description	Volume
Bunker tank No. 3 (port)	1,230 m^3
Bunker tank No. 2 (starboard)	909 m^3
Bunker tank No. 1 (starboard)	527 m^3
Overflow tank	47.7 m^3
Settling tank No. 1	108 m^3
Service tank No. 2	93 m^3
2 × day tanks (for fire pumps)	2 × 6 m^3
1 × day tanks (for emergency generator)	1 × 6 m^3

3.9.2 Chemical Usage

Chemicals are used on the Okha FPSO for various purposes. and can be divided into two broad categories—operational and non-operational—as described below.

3.9.2.1 Operational Chemicals

Operational Process Chemicals

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

Operational Non-Process Chemicals

Non-process chemicals are those that do not fall into the category described above. They may be required for operational reasons (e.g. maintenance or intervention activities) and once used, may be intermittently discharged or have the potential to be discharged. Examples include subsea control fluids, dyes, and well intervention/workover chemicals.

3.9.2.2 Non-Operational Chemicals

Non-operational chemicals include those required for general maintenance or housekeeping activities and are critical for overall maintenance of the Okha FPSO and its equipment. These may include paints, degreasers, greases, lubricants, and domestic cleaning products, as well as chemicals used for special tasks, such as laboratory testing and analysis. Maintenance chemicals generally present negligible risk to the environment because they are either not discharged when used (e.g. paint) or are used intermittently and discharged in low volumes (e.g. domestic cleaning products).

3.9.2.3 Indicative Chemical Inventories

Table 3-5 lists the bulk chemicals commonly used on the Okha FPSO, and their estimated storage quantities. In addition to these, the Okha FPSO may also store small volumes of various operational chemicals and facility maintenance chemicals as described above.

Table 3-5: Indicative bulk inventories of chemicals

Material	Storage Method	Storage Capacity (m^3)
Biocide	Dedicated tank – chemical injection skid	~9
Scale inhibitor	Dedicated tank – chemical injection skid	~8
Emulsion breaker	Dedicated tank – chemical injection skid	~13
Reverse emulsion breaker	Dedicated tank – chemical injection skid	~11
TEG	Dedicated tank	~10
Subsea control fluid	Fluid stored in intermediate bulk containers	~4

3.9.2.4 Environmental Consideration during Chemical Selection, Assessment, and Approval

Operational chemicals required by the Petroleum Activities Program are selected and approved in accordance with Woodside's process for selecting and assessing chemicals. This process is used to demonstrate that the potential impacts of the chemicals selected are acceptable and ALARP, and that they meet Woodside's corporate requirements, which requires chemicals to be selected with the lowest practicable environmental impacts and risks, subject to technical constraints.

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

Environmental Selection Criteria

Woodside's process for selecting and assessing chemicals follows the principles outlined in the Offshore Chemical Notification Scheme (OCNS), which manages chemical use and discharge in the United Kingdom (UK) and the Netherlands (background on the OCNS scheme is provided below).

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

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

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

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

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

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

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

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

Background Overview of OCNS

The OCNS applies the requirements of the Oslo–Paris 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 list of registered products have an assigned ranking based on toxicity and other relevant parameters (e.g. biodegradation, bioaccumulation), in accordance one of two schemes (as shown in Figure 3-9):

- **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). Applied to inorganic substances, hydraulic fluids, and pipeline chemicals only.

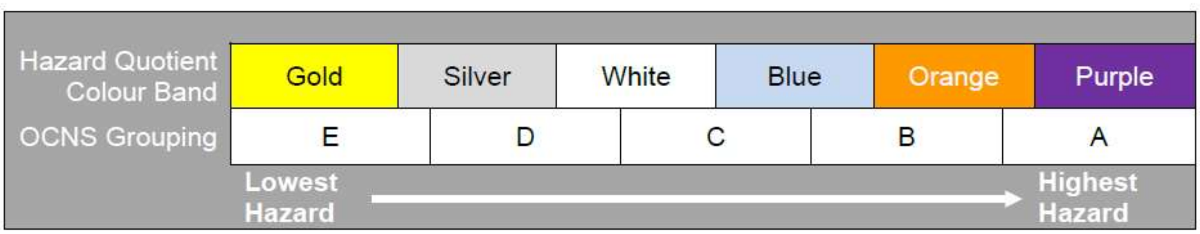

Figure 3-9: OCNS ranking

3.10 Subsea Inspection, Monitoring, Maintenance, and Repair Activities

3.10.1 Overview

Subsea infrastructure is designed not to require any significant degree of intervention. However, inspection, monitoring and maintenance is undertaken to ensure the integrity of the infrastructure and identify any issues before they present a risk of loss of containment. Intervention may be required to repair identified issues. Subsea activities are typically undertaken from a relevant support vessel via an ROV and/or divers.

Interventions often require deployment frames/baskets, which are temporarily placed on the seabed. Typically, these have a perforated base with a seabed footprint of ~15 m^2. They are recovered to the vessel at the end of the activity. Subsea activities are broadly categorised into inspection, monitoring, maintenance, and repair activities, and typical IMMR activities are described below.

3.10.1.1 Inspection

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 scope and frequency of subsea and pipeline inspections are determined using risk-based inspection (RBI) methodology, resulting in detailed RBI plans. Table 3-6 lists typical subsea infrastructure inspections / surveys.

Table 3-6: Typical inspections / surveys

Type of Inspection / Survey	Purpose
General visual inspections	Check general infrastructure integrity
Close visual inspections	Investigate certain subsea infrastructure components
Cathodic protection	Check the system is protected against corrosion
Wall thickness surveys	Monitor the condition of subsea infrastructure. (i.e. ultrasonic testing)
Side scan sonar (SSS), multibeam echo sounder (MBES) and sub-bottom profiler (SBP) (Chirp)	Identify buckling, movement, scour, and seabed features. Low frequency/intensity signals
Non-destructive testing	Evaluate the properties of material/items using electromagnetic, radio graphic, acoustic resonance technology, ultrasonic, or magnetic equipment
Seabed sampling surveys including minor grabs/cores	Identify benthic fauna, sediment, etc. Grabs/cores are typically 0.1 m^2 per sample
Water sampling surveys	Determine water quality around pipelines
Anode sampling	Take samples of anode materials for testing
Marine growth sampling	Take samples of marine growth for testing
Laser surveys	Conduct dimensional checks on spools etc. and measure proximity

3.10.1.2 Monitoring

Subsea infrastructure monitoring surveys the physical and chemical environment that a subsea system or component is exposed to, to determine if and when damage may occur, and (where relevant) predict the rate or extent of that damage.

Monitoring activities may include process composition testing, corrosion probes, corrosion mitigation checks, metocean and seismic monitoring, and cathodic protection testing.

3.10.1.3 Maintenance

Maintenance activities on subsea infrastructure are required at regular or planned intervals to prevent deterioration or integrity failure. Maintenance activities may include cycling and actuating valves, flushing chemical/hydraulic fluid lines, and leak and pressure testing.

3.10.1.4 Repair

Repair activities are 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, environment, or production. Typical subsea repair activities include, but are not limited to:

- SCM replacement
- hydraulic flying lead replacement

- electrical flying lead replacement
- pipeline or spool support with grout bag or mattress
- spool disconnection and/or replacement
- umbilical jumper replacement
- riser or flowline replacement
- scour prevention installation
- corrosion protection.

3.10.1.5 Pipeline Pigging Operations

Pigging involves sending an internal pig through a pipeline using a process medium. During the pipeline lifecycle, pigging may need to be conducted for various reasons (e.g. IMMR or to facilitate modifications).

The WC GEL has been designed to operate in a non-corrosive condition, thus regular maintenance and cleaning pigging of the WC GEL is not required. Therefore, permanent pig launchers or receivers are not part of the subsea infrastructure. If any pigging activity was needed, a temporary subsea launcher and receiver would need to be installed. Flanged connections are provided in suitable locations to connect pig traps to allow pigging.

The risks and impacts of unscheduled pigging are included in Section 6.6.4.

3.10.1.6 Chemical Usage During IMMR Activities

Subsea Chemical Usage

Planned chemical discharges may occur during various subsea system operation and IMMR activities. However, these are either discharged in small volumes, or discharged intermittently. Operational chemicals used in the Okha FPSO subsea infrastructure are selected and assessed using Woodside's chemical selection and assessment procedures, as detailed in Section 3.9. Chemicals that may be released during IMMR activities; include, but are not limited to:

- subsea control fluid – a water-glycol based control fluid. The subsea control system is an open-loop system that releases hydraulic fluid during valve functioning and releases small quantities across control valves during steady-state operations
- 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 pipelines that may cause corrosion
- dye – chemical dyes incorporated in the subsea 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
- surfactant – surfactants remove water and organic deposits from pipelines
- grout – the material used in grout, mattresses, and rock is typically concrete-based.

Typical Discharges During IMMR Activities

Minor environmental discharges are expected during subsea IMMR activities (e.g. during pressure / leak testing or flushing). Where possible, flushing is performed before a subsea component is disconnected to reduce residual hydrocarbon or chemical releases to the environment upon disconnection. The flushing chemicals used for this activity may be supplied from either the Okha FPSO or a chemical package via a support vessel. Where possible, flushed fluids will return to the Okha FPSO and be processed and treated through the production system. Table 3-7 lists typical discharge volumes during different IMMR activities.

Table 3-7: Typical discharge volumes during different IMMR and subsea activities

Activity	Typical Discharge
Pressure/leak testing and investigation	Investigation initiated if subsea hydraulic consumption is >130 L per day.
Valve functioning	0.5 L to 6 L per valve actuation per Xmas tree and manifold Facility shutdown (cyclone disconnect) ~170 L per shut down across control system (estimated 1-2 shutdowns per year). Standard facility shutdown ~ 170 L per shutdown across control system (estimated 8 – 10 shutdowns per year).
Flushing	Residual hydrocarbon or chemical releases volume depends on injection port size, component geometry, and pumping rates
Hot stab change out	Hydrocarbons or subsea control fluid <10 L.
SCM changeout	Typical releases: acid ~400 L; subsea control fluid ~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
Flowline or spools repair, replacement, and recovery	Typical release of hydrocarbon or other chemicals depends on equipment configuration and flushing ability. This will be subject to an ALARP determination for the activity, as per normal practice.

3.10.1.7 Marine Growth Removal

Due to the relatively high rate of marine growth on the NWS, excess growth may need to be removed before undertaking many subsea IMMR activities. An ROV or a diver is used for this activity; Table 3-8 lists the different techniques used.

Table 3-8: Marine growth removal methods

Activity / Equipment	Description
Water jetting	Uses HP water to remove marine growth
Brush systems	Uses brushes attached to an ROV to physically remove marine growth
Acid (typically sulfamic acid)	Chemically dissolves calcium deposits

3.10.1.8 Sediment Relocation

If sediment builds up around subsea infrastructure, an ROV-mounted suction pump/dredging unit may be used to move small amounts of sediment in the immediate vicinity (i.e. within the existing footprint). This allows inspection/intervention works to be undertaken. Sediment relocation typically results in minor seabed disturbance and some localised turbidity.

3.10.1.9 Redundant Equipment

To meet the requirements of the OPGGS Act (Section 1.10.1.1), the activities to achieve permanent plugging of PTA and ETA wells within a reasonable timeframe are described below. The ongoing preservation and maintenance of redundant subsea infrastructure to enable removal or other satisfactory arrangement at the end of production, is also described below.

Temporary Abandoned Production Wells

Woodside is conducting an ALARP assessment in 2020 relating to defining a time to plug and abandon PTA wells and associated infrastructure as soon as reasonably practicable, in accordance with the CWLH WOMP. This will consider the current status of well integrity barriers (including the placement of suspension plugs in WA03 and WA11 in late 2019), the ability to monitor well barriers, future planned field activities, the safety/environmental risks associated with extensive work adjacent live infrastructure, the overall end of field life (EOFL) for all wells/infrastructure in the CWLH Area, and the financial implications associated with P&A timing options. A time to abandon these wells, as a result of the assessment, will be included in the 5-yearly CWLH WOMP revision and resubmission to NOPSEMA in 2021.

Temporary Abandoned Exploration Wells

In line with the WOMP commitment relating to ETA wells, Woodside has completed a detailed subsurface/technical assessment across the entire exploration well portfolio. This has concluded that the wells in this EP have been abandoned according to the relevant regulatory requirements and that these wells have permanent downhole barriers. These wells will be included in new WOMPs to enable NOPSEMA to undertake its assessment, and enable subsequent abandonment applications to be made. This process of submission has commenced across Woodside's portfolio of exploration wells. The intention is for the WOMPs for exploration wells in this EP to be submitted in the second half of 2020.

Woodside shall then recommence decommissioning planning for the exploration wellhead infrastructure which ceased in late 2018 to enable the activities noted above to be undertaken. Planning shall be premised upon removal as the base case for decommissioning, however, alternate arrangements will be considered (as per the Comparative Assessment undertaken in 2018). Once defined, an EP will be developed for the decommissioning activity. Due to contracting, engineering, stakeholder consultation and allowance for any unforeseen circumstances, the anticipated submission date for the EP is 2021.

Redundant Subsea Infrastructure

Woodside maintains a database of all wet stored, redundant subsea infrastructure items and locations. No EOFL decommissioning activities for the infrastructure are planned for the life of this 5-year EP. If during the operational lifecycle, equipment is degraded, damaged, or has deteriorated to a level outside acceptance limits for use to the point where replacement is required, the redundant equipment may be wet stored on the sea floor until EOFL decommissioning.

Redundant infrastructure currently in-situ includes flowlines, umbilicals, production jumpers, and ancillary equipment. The CWLH fields contain approximately 21 km of redundant flowlines which have been physically disconnected from the producing system. Before redundant flowlines are disconnected and wet stored, they are flushed to reduce the concentration of hydrocarbons within them to ALARP and then filled with preservation fluid. A high level assessment has determined that the rate of degradation of the redundant flowlines would be minor and as such normal field removal techniques could be applied as part of field decommissioning.

For the redundant Okha equipment, removal of property throughout the operational life is not considered to be ALARP for the following reasons:

- Redundant equipment is incorporated within or located close to live infrastructure which introduces additional complexities and HSE risk that can be avoided during EOFL decommissioning.

- While subsea equipment is in-situ, risks and impacts to other marine users are considered to be low (Section 6.6.1)
- Wet stored subsea infrastructure is RBI assessed and managed while preserved to ensure integrity and retrieval options are maintained for potential full removal.
- Cost of standalone retrieval work scopes are considered disproportionate when considering the risks of retrieval during current operations versus risk of extending duration in-situ.
- The environmental risks and impacts when leaving redundant infrastructure in-situ under current operations is considered to be low.

As the CWLH fields are predicted to remain active during the life of this EP, decommissioning activities will be further defined approximately 2 – 5 years out from EOFL, in line with Woodside's Decommissioning Management Procedure. Further detail on decommissioning activities will be provided in future EPs.

4. DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Overview

In accordance with Regulation 13(2) and 13(3) of the Environment Regulations, this section describes the existing environment that may be affected by the activity (planned and unplanned, as described in Section 6.6, 6.7 and 6.8), including details of the particular relevant values and sensitivities of the environment, which were used for the risk assessment.

The EMBA is the largest spatial extent where unplanned events could have an environmental consequence on the surrounding environment. For this EP, the EMBA is the 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 6.8.1.2. 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 6.8.1.2. 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, 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.

It should be noted that 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 instant in time. Rather, the areas are a composite of a large number of theoretical paths, integrated over the full duration of the simulations under variations in 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, is below concentrations at which ecological impacts are expected to occur. This low exposure value also establishes planning area for scientific monitoring (NOPSEMA guidance note: A652993, April 2019).	
Dissolved Entrained	400 ppb This represents potential toxic effects, particularly sublethal effects to highly sensitive species. This is conservative given that it is based on the lowest 'no effect concentration' (NOEC) observed in Woodside's ecotoxicity testing for the specific crude on the FPSO of 407 ppb (refer to Section 6.8.1.2). As entrained and dissolved hydrocarbons are within the water column and not visible, impacts to socio-cultural receptors are associated with ecological impacts. Therefore, dissolved and entrained at this threshold also represents the level at which socio-cultural impacts may occur.		10 ppb This low exposure value establishes planning area for scientific monitoring (based on potential for exceedance of water quality triggers) (NOPSEMA guidance note: A652993, April 2019). This area is described further in Appendix D: Figure 5-1.

		In the event of a spill, DNP will be notified of AMPs which may be contacted by hydrocarbons at this threshold Table 5-1.

[1] *Further details including the source of the thresholds used to define the EMBA in this table are provided in Section 6.8.1.2.*

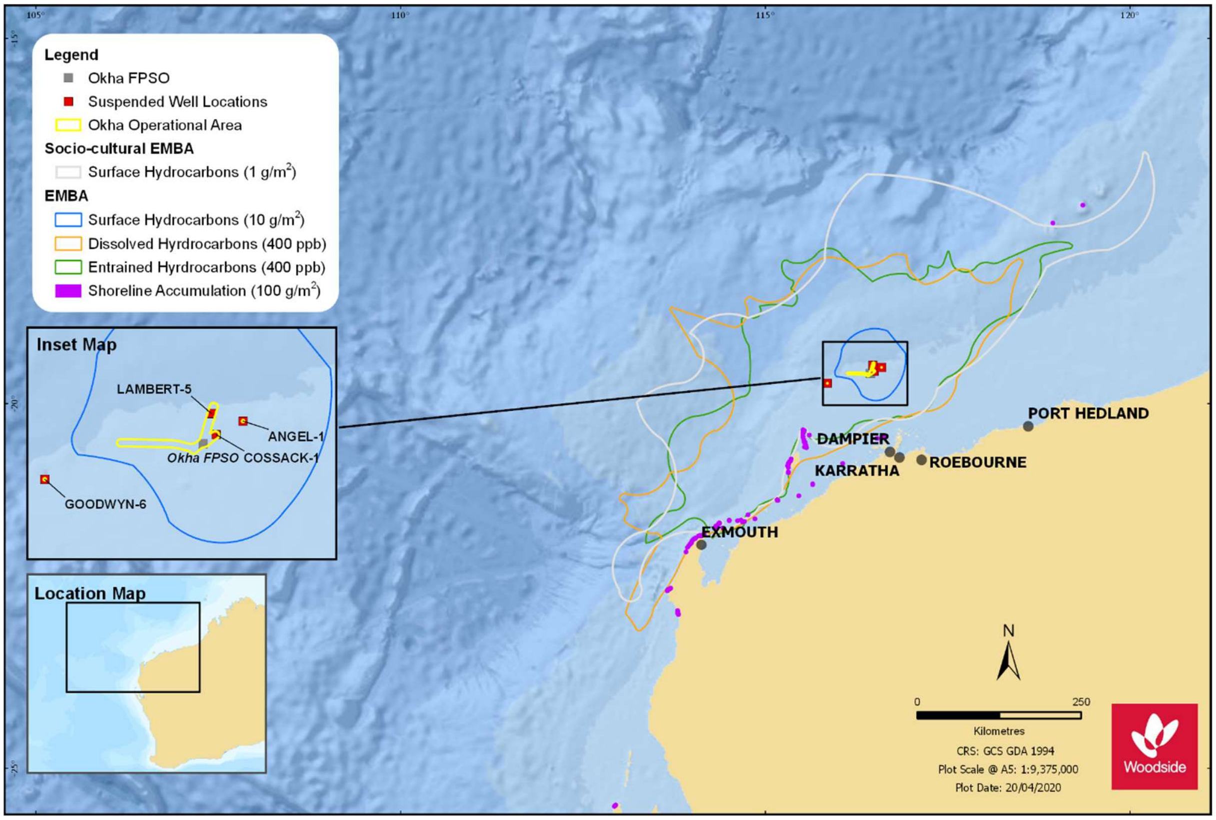

Figure 4-1: Hydrocarbon Spill Thresholds used to Define EMBA and Socio-cultural EMBA for Surface and In-water Hydrocarbons

4.2 Summary of Key Existing Environment Characteristics

Table 4-2 summarises the key existing environment characteristics, in line with the process of identifying and describing the existing environment in relation to the 'nature and scale' of the activity (refer Section 2.4.2). These key existing environment characteristics are described in terms of the Operational Area, socio-cultural EMBA and the EMBA.

Table 4-2: Summary of key existing environment characteristics

Sensitive Receptor		EP Section	Description
Physical Environment	***Climate and Meteorology***	4.4.1	*Operational Area and Wider EMBA* • tropical monsoon climate with hot summers and mild winters • most rainfall occurs during late summer and autumn • seasonal wind patterns with south-westerly winds characterising summer months and easterly winds characterising winter. Winds during transition period between seasons typically more variable • tropical cyclones regularly occur in the region during summer period.
	Oceanography	4.4.2	*Operational Area* • locally generated wind surface currents are superimposed on geostrophic and tidal currents • geostrophic flow characterised by the southward flowing Leeuwin current, which strengthens in late summer and winter • water quality is expected to reflect the offshore oceanic conditions of the North West Shelf Province (NWS Province) and wider region • surface water temperatures are relatively warm, ranging seasonally from ~24.3 to 28.5 °C • offshore waters are expected to be of high quality given the distance from shore and lack of terrigenous inputs. *Wider EMBA* • water quality is regulated by the Indonesian Throughflow (ITF), which plays a key role in initiating the Leeuwin Current and brings warm, low-nutrient, low-salinity water to the North-west Marine Region (NWMR). It is the primary driver of the oceanographic and ecological processes in the NWS Province • variation in surface salinity throughout the year is minimal (35.2 and 35.7 practical salinity units [PSU]) • during summer, the Leeuwin Current typically weakens and the Ningaloo Current develops, facilitating upwelling of cold, nutrient-rich waters up onto the continental shelf • other areas of localised upwelling in the NWMR include the Exmouth Plateau, where seabed topographical features force the surrounding deeper, cooler, nutrient rich waters up into the photic zone • turbidity is primarily influenced by sediment transport by oceanic swells and primary productivity.
	Bathymetry	4.4.3	*Operational Area* • located in waters ~75–130 m deep along the continental shelf • generally flat with gentle gradient. *Wider EMBA* • relatively complex bathymetric features are found at Rankin Bank to the east and Glomar Shoal to the west of the Operational Area • numerous Key Ecological Features (KEFs) associated with bathymetric features in the wider EMBA.

<table>
<tr><th colspan="2">Sensitive Receptor</th><th>EP Section</th><th>Description</th></tr>
<tr><td rowspan="2"></td><td>Marine Sediment</td><td>4.4.4</td><td>Operational Area
• comprises fine sediments (from muds to sands) of high quality (low levels of contaminants)
• sediments are expected to consist primarily of carbonates.
Wider EMBA
• sediment characteristics change with depth and distance from shore, with sediments becoming progressively finer with increasing depth and distance, particularly beyond continental shelf break.</td></tr>
<tr><td>Air Quality</td><td>4.4.5</td><td>There is limited air quality data for the NWS Province. However, ambient air quality in the Operational Area and wider EMBA is expected to be of high quality.</td></tr>
<tr><td rowspan="4">Habitats</td><td>Critical Habitat – EPBC Listed</td><td>4.5.1.1</td><td>No Critical Habitats or Threatened Ecological Communities, as listed under the EPBC Act, are known to occur within the Operational Area. Refer to the relevant section for each protected species for a description of the critical habitats that may occur within the wider EMBA.</td></tr>
<tr><td>Marine Primary Producers</td><td>4.5.1.2</td><td>Given the water depth, benthic primary producers will not occur within the Operational Area:
<u>Coral Reefs</u>
Wider EMBA
• nearest coral habitat to the Operational Area is Rankin Bank
• coral reef habitats include Glomar Shoal, the Montebello/Barrow/Lowendal Islands Group, Barrow Island and Ningaloo Coast.
<u>Seagrass Beds / Macroalgae</u>
Wider EMBA
• nearest seagrass/macroalgae habitat is widely distributed in coastal waters that receive sufficient light to support seagrass and macroalgae.
<u>Mangroves</u>
Wider EMBA
• broadly distributed in protected coastlines throughout the wider EMBA.</td></tr>
<tr><td>Life Cycle Stages ‘Critical’ Habitats</td><td>4.5.1.3</td><td>Refer to Biologically Important Areas (BIAs) and species descriptions.</td></tr>
<tr><td>Other Communities/ Habitats</td><td>4.5.1.4</td><td><u>Plankton</u>
Operational Area
• plankton communities in the Operational Area are likely to reflect the broader NWS Province.
Wider EMBA</td></tr>
</table>

Sensitive Receptor		EP Section	Description
			• offshore phytoplankton communities in the NWS Province are characterised by smaller taxa (e.g. bacteria), while shelf waters are dominated by larger taxa (e.g. diatoms) • peak primary productivity along the shelf edge of the Ningaloo Reef occurs in late summer/early autumn. Pelagic and Demersal Fish Populations *Operational Area* • fish communities in the Operational Area comprise small and large species pelagic fish, as well as demersal species associated with subsea infrastructure • Ancient Coastline at 125 m KEF may support demersal fish assemblages. *Wider EMBA* • key demersal fish biodiversity areas are likely to occur in other complex habitats, e.g. coral reefs • relatively complex habitats (e.g. reefs, Rankin Bank, Glomar Shoal) support high demersal fish richness and abundance. Filter Feeders *Operational Area* • filter feeders are generally located in areas with strong currents and hard substratum, and have developed on subsea infrastructure in the Operational Area • low to moderate density filter feeders widely distributed in surveyed portions of Operational Area. *Wider EMBA* • the NWMR has been identified as a sponge diversity hotspot with a variety of areas with high biodiversity, particularly in the Ningaloo Marine Park. Benthic Communities *Operational Area* • sparse assemblages of epifauna and infauna in the Operational Area, including polychaetes and crustaceans. *Wider EMBA* • areas of hard substrate expected to host relatively diverse benthic communities.
Protected Species	***Biologically Important Areas (BIAs)***	4.5.2.3	*Operational Area* • foraging area for the wedge-tailed shearwater during its breeding season (August to April) • whale shark foraging area northward from Ningaloo along the 200 m isobath, with seasonally high use (April to June). *Wider EMBA* • large number of BIAs within wider EMBA.
	Marine Mammals	4.5.2.5	*Operational Area* • sei whale – there are no known key aggregation areas (resting, breeding or feeding) located within the Operational Area

Sensitive Receptor		EP Section	Description
			• Bryde's whale – tropical and temperate waters, with inshore and offshore morphologies / populations. May be seasonally present between December and June • blue whale – there are no known key aggregation areas (resting, breeding or feeding) located within the Operational Area, however they may be likely to occur • fin whale – there are no known key aggregation areas (resting, breeding or feeding) located within the Operational Area • humpback whale – humpback whales may transit through the Operational Area during their northbound and southbound migrations (although typically occur inshore of the Operational Area), likely between June and September (including northbound and southbound migration) • sperm whale – unlikely to occur in Operational Area due to preference for oceanic waters • Antarctic minke whale – migrates up to 20 °S for feeding and possible breeding. Unlikely to occur within Operational Area • southern right whale – unlikely to occur in Operational Area • killer whale, orca – no recognised key localities, expected to rarely occur. *Wider EMBA* • a range of migratory cetacean species occur, including several dolphin species • resident coastal populations of small cetacean species • dugong – known to occur in tropical coastal environments where seagrasses occur, including Ningaloo Marine Park • Antarctic minke whale – migrates up to 20 °S for feeding and possible breeding. Unlikely to occur within Operational Area but may occur in wider EMBA • southern right whale – unlikely to occur in Operational Area, may occur in southern extent of EMBA.
	Marine Turtles	4.5.2.6	*Operational Area* • the Operational Area does not contain any known critical habitat or BIAs for any species of marine turtle • presence of the five species of threatened marine turtles (loggerhead, green, leatherback, hawksbill and flatback) within the Operational Area is likely to be infrequent and limited to individuals or small numbers transiting, as they seasonally move in and out of key foraging, internesting and nesting locations • given benthic habitat present at Glomar Shoal, marine turtles may forage within more shallow areas of the KEF (i.e. outside the Operational Area); however, this is not a known foraging location or listed BIA. *Wider EMBA* • green, loggerhead, flatback and hawksbill turtles have significant nesting rookeries on beaches along the Montebello/Barrow/Lowendal Islands Group, Ningaloo coast and the Muiron Islands. Leatherback turtles may occur within the wider EMBA but there are no known nesting beaches in WA • marine turtles may forage in shallow waters on the continental shelf, including Rankin Bank.

Sensitive Receptor		EP Section	Description
	Sea Snakes	4.5.2.6	*Operational Area* • given the offshore location and deeper water depths of the Operational Area, sea snake sightings will likely be infrequent and comprise a few individuals but may be more prevalent within the Operational Area. *Wider EMBA* • sea snakes frequent the waters of the continental shelf and around offshore islands.
	Fishes and Elasmobranchs	4.5.2.7	*Operational Area* • the EPBC Act Protected Matters Search Tool (PMST) identified ten species of Threatened and/or Migratory sharks (grey nurse shark, great white shark, green sawfish, whale shark, narrow sawfish, shortfin mako, longfin mako, reef manta ray, giant manta ray and green sawfish) that may occur in the Operational Area • the Operational Area overlaps the whale shark foraging BIA (although it may constitute part of the migration corridor for animals moving to and from annual aggregation off Ningaloo Reef). *Wider EMBA* • whale sharks are known to aggregate annually, from March to July, in areas off Ningaloo Reef and North West Cape. After the aggregation period, the distribution of the whale sharks is largely unknown but surveys suggest that the group disperses widely and up to 1800 km away to areas in Indonesia, Christmas Island and Coral Sea • Ningaloo Reef is an important area for giant and reef manta rays in autumn and winter, and they are known to occur in tropical waters throughout the wider EMBA • grey nurse sharks are likely to be found in shallow waters of the wider EMBA • sawfish may occur in shallow coastal habitats • great white sharks, shortfin makos and longfin makos are all known to occur within the wider EMBA • porbeagle shark may occur in temperate waters in the southern portion of the wider EMBA.
	Birds	4.5.2.8	*Operational Area* • ten species of Threatened and/or Migratory bird species (red knot, eastern curlew, common noddy, streaked shearwater, lesser frigatebird, great frigatebird, common sandpiper, sharp-tailed sandpiper, pectoral sandpiper, and osprey) were identified as potentially occurring within the Operational Area. No critical habitat associated with these species has been identified within the Operational Area • a BIA for wedge-tailed shearwater, during their breeding season, overlaps the Operational Area. *Wider EMBA* • several BIAs (key breeding/nesting, roosting, foraging and resting areas) for seabirds and migratory shorebirds occur in the wider EMBA, including areas on the islands of the Montebello/Barrow/Lowendal Islands group, Pilbara Islands, Ningaloo Coast and Muiron Islands.

Sensitive Receptor		EP Section	Description
Socioeconomic	***Cultural Heritage***	4.6.1	*Operational Area* • there are no known sites of Indigenous or European cultural or heritage significance within or in the vicinity of the Operational Area. *Wider EMBA and Socio-cultural EMBA* • Barrow Island, Montebello Islands, Dampier Archipelago, Ningaloo Reef and the adjacent foreshore contain numerous registered Indigenous heritage sites • the closest recorded Maritime Cultural Heritage sites to the Operational Area are the *McCormack* and *McDermott Derrick Barge No. 20* shipwrecks, both ~47 km south of the Operational Area • World Heritage Areas (WHAs) include the Ningaloo Coast WHA • National Heritage listed and proposed places include Barrow Island, Montebello Islands, Dampier Archipelago and Ningaloo Coast • Commonwealth Heritage listed places include the Ningaloo Marine Area – Commonwealth Waters.
	Ramsar Wetlands	4.6.2	No Ramsar wetlands occur in the Operational Area or wider EMBA.
	Fisheries – Commercial	4.6.3	*Operational Area* There are a number of Commonwealth and State fisheries designated management areas that overlap the Operational Area; however, only the State Pilbara Demersal Scalefish Fishery is expected to be active within the Operational Area: • Commonwealth fisheries: – Southern Bluefin Tuna Fishery – Western Skipjack Tuna Fishery – Western Tuna and Billfish Fishery • State fisheries: – Pilbara Demersal Scalefish Fishery – West Coast Deep Sea Crustacean Managed Fishery – Nickol Bay Prawn Managed Fishery – Onslow Prawn Managed Fishery – Pearl Oyster Managed Fishery – Marine Aquarium Fish Managed Fishery – Western Australian Abalone Fishery – Mackerel Managed Fishery – South West Coast Salmon Managed Fishery

Sensitive Receptor		EP Section	Description
			• there are no aquaculture activities within or adjacent to the Operational Area. *Wider EMBA and Socio-cultural EMBA* • a number of State and Commonwealth fisheries overlap the EMBA.
	Fisheries – Traditional	4.6.4	There are no known traditional or customary fisheries within or adjacent to the Operational Area. Traditional fisheries are typically restricted to shallow coastal waters and/or areas with structure such as reef. Ningaloo Coast, Barrow Island and Montebello Islands and the adjacent foreshores have a known history of fishing, when areas were occupied (as identified from historical records). Traditional fishing still occurs within coastal waters of the Dampier Archipelago.
	Tourism and Recreation	4.6.5	*Operational Area* • tourism activities in the Operational Area are not known to occur due to water depths and distance offshore. *Wider EMBA and Socio-cultural EMBA* • recreational fishing is expected to occur throughout wider EMBA, primarily in continental shelf waters including Rankin Bank • the Ningaloo Marine Park and Montebello Islands are popular for marine nature-based tourist activities.
	Shipping	4.6.6	*Operational Area* • several shipping fairways overlap the Operational Area. *Wider EMBA* • the coastal and offshore waters of the region support significant commercial shipping activity, most of which is associated with the mining and oil and gas industries • major shipping routes are associated with entry to the ports of Barrow Island, Dampier, Onslow and Port Hedland.
	Oil and Gas Infrastructure	4.6.7	*Operational Area* • GWA is 22 km south-west of the Operational Area and 54 km from the Okha FPSO • NRC lies within the western extremity of the Operational Area and Angel overlaps the Angel-1 suspended exploration well section of the Operational Area. These facilities are 32 and 20 km from the Okha FPSO, respectively. *Wider EMBA* • there are numerous petroleum titles surrounding the Operational Area • several fixed platforms are located near the Operational Area, including GWA, Pluto, Angel, Wheatstone, and Reindeer.
	Defence	4.6.8	There are designated defence practice areas in the offshore marine waters off Ningaloo Reef and the North West Cape, beyond the Operational Area.

Sensitive Receptor		EP Section	Description
Values and Sensitivities	***Montebello / Barrow / Lowendal Islands***	4.7.1	No protected areas overlap the Operational Area. Within the wider EMBA and Socio-cultural EMBA protected areas include: • Montebello AMP • Montebello Islands Marine Park, Barrow Island Marine Park, Barrow Island Marine Management Area • Barrow Island Nature Reserve • Lowendal Islands Nature Reserve.
	Ningaloo Coast and Gascoyne	4.7.2	No protected areas overlap the Operational Area. Within the wider EMBA and Socio-cultural EMBA protected areas include: • Ningaloo Coast WHA and National Heritage Area • Ningaloo AMP • Ningaloo Marine Park and Muiron Islands Marine Management Area • Gascoyne AMP.
	Pilbara Coast and Islands	4.7.3	No protected areas overlap the Operational Area. Within the wider EMBA and Socio-cultural EMBA protected and sensitive areas include: • Dampier AMP • Dampier Archipelago State Nature Reserve • Dampier Archipelago National Heritage Place • Pilbara Islands (north group) • Pilbara Islands (middle group) • Pilbara Islands (south group).
	Rowley Shoals	4.7.4	No protected areas overlap the Operational Area. Within the wider EMBA and Socio-cultural EMBA protected and sensitive areas include: • Argo-Rowley Terrace AMP.
	Key Ecological Features	4.7.5	*Operational Area* • Ancient Coastline at 125 m Depth Contour. *Wider EMBA* • A number of KEFs occur within the wider EMBA.
	Other Sensitive Areas	4.7.6	Rankin Bank lies approximately 21 km west of the Operational Area at the closest point (i.e. from the Goodwyn-6 suspended exploration well section of the Operational Area).

4.3 Regional Context

The Operational Area is located in Commonwealth Waters within the NWS Province, in water depths of ~75–130 m. The NWS Province is part of the wider NWMR (Figure 4-1) as defined under the Integrated Marine and Coastal Regionalisation of Australia (National Oceans Office and Geoscience Australia 2005). The NWS Province encompasses the continental shelf between North West Cape and Cape Bougainville, and varies in width from ~50 km at Exmouth Gulf to >250 km off Cape Leveque and includes water depths of 0–200 m (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a).

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

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

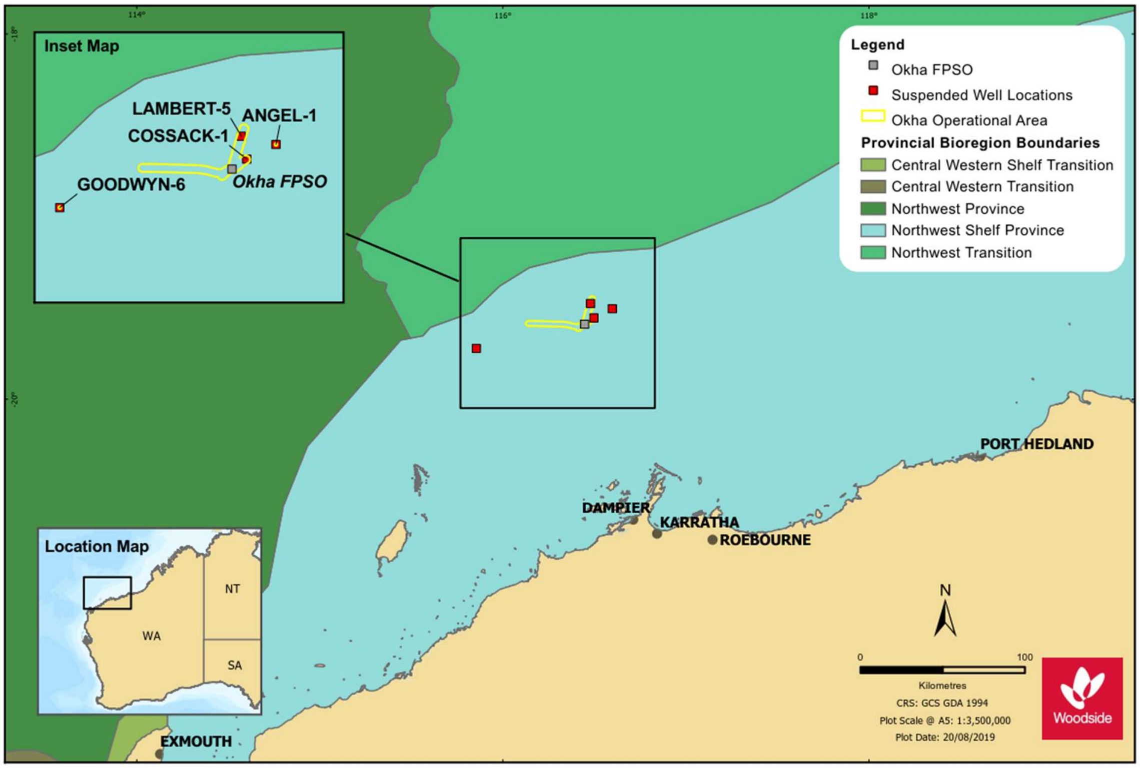

Figure 4-2: NWMR and the location of the Operational Area

4.4 Physical Environment

4.4.1 Climate and Meteorology

4.4.1.1 Seasonal Patterns

The Operational Area experiences a tropical monsoon climate, with distinct wet (October to April) and dry (May to September) seasons (Pearce et al. 2003). Rainfall in the region typically occurs during the wet season, with highest falls observed during late summer (Bureau of Meteorology [BoM] n.d.) and is often associated with the passage of tropical low-pressure systems and cyclones (Pearce et al. 2003). Rainfall outside this period is typically low (Figure 4-3).

Air temperatures in the region, as measured at Karratha Aerodrome, follow seasonal trends (Figure 4-3). Maximum temperatures during summer reach an average of 36 °C in January, falling to an average maximum of 26 °C in July. Average minimum temperatures range from 26 °C in January to 14 °C in July.

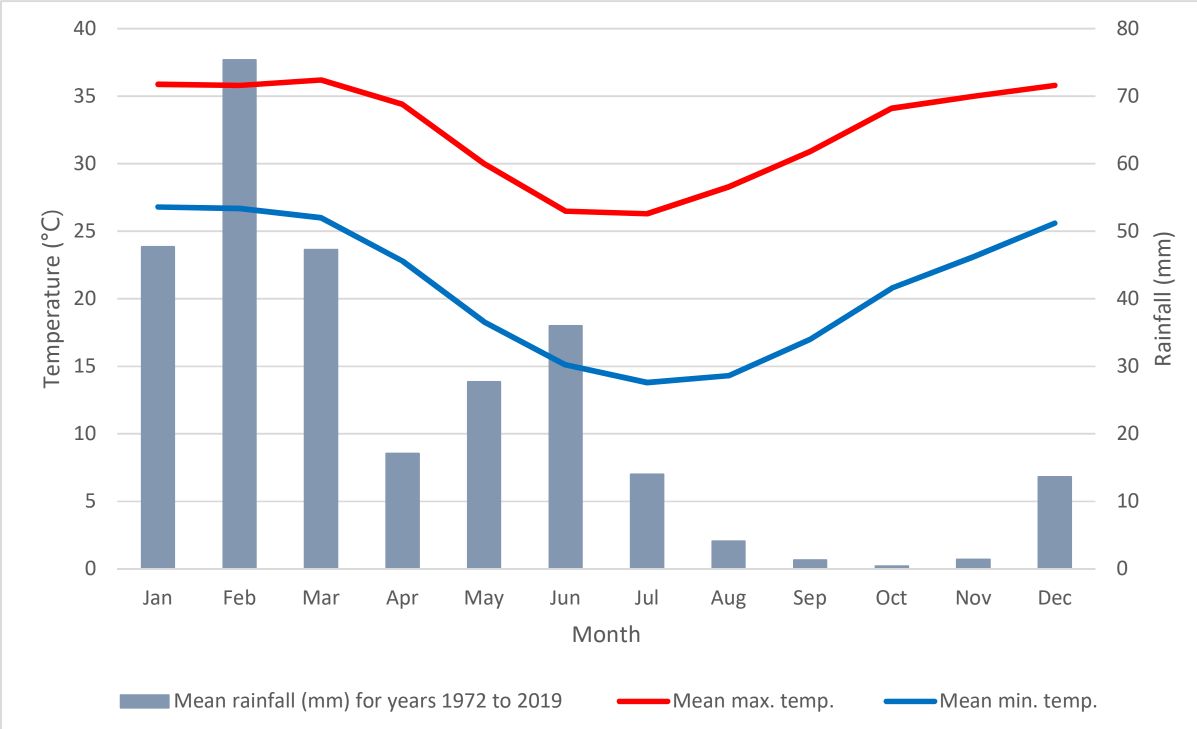

Figure 4-3: Mean monthly maximum temperature, minimum temperature and rainfall from Karratha Aerodrome meteorological station from January 1993 to June 2019

Source: BoM (n.d.)

4.4.1.2 Wind

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

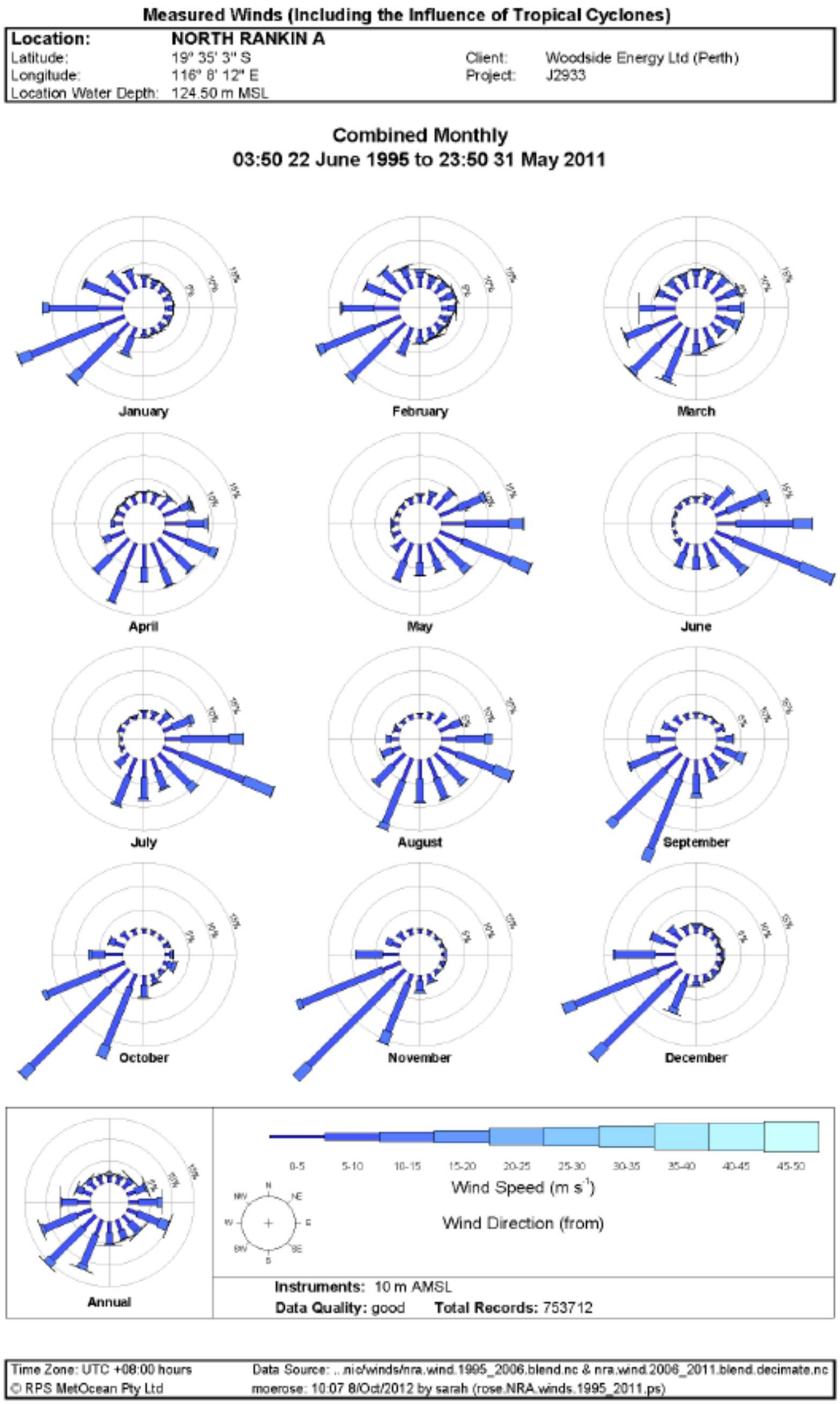

Figure 4-4: NWS monthly and annual wind roses derived from NRC measured 1995–2011 wind data

4.4.1.3 Tropical Cyclones

Cyclones are a relatively frequent event in the region (Figure 4-5), with the Pilbara coast experiencing more cyclonic activity than most other regions of the Australian mainland coast (BoM n.d.). 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).

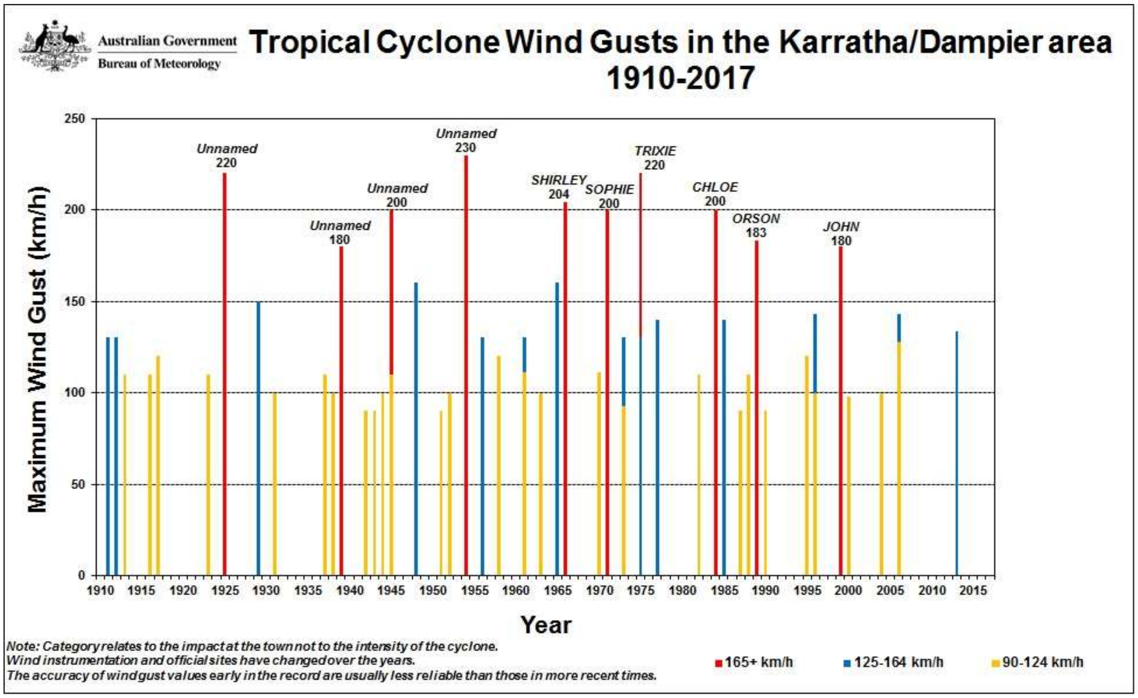

Figure 4-5: Tropical cyclone activity in the Dampier/Karratha region 1910–2017

Source: BoM (n.d.)

4.4.2 Oceanography

4.4.2.1 Currents and Tides

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

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

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

In addition to the geostrophic current dynamics, tidally driven currents are a significant component of water movement in the NWMR. Wind-driven currents become dominant during the neap tide (Pearce et al. 2003). In summer, the stratified water column and large tides can generate internal waves over the upper slope of the NWMR (Craig 1988). As these waves pass the shelf break at ~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 m and 1000 m and the dissipation energy from such waves can enhance mixing in the water column (Holloway et al. 2001).

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

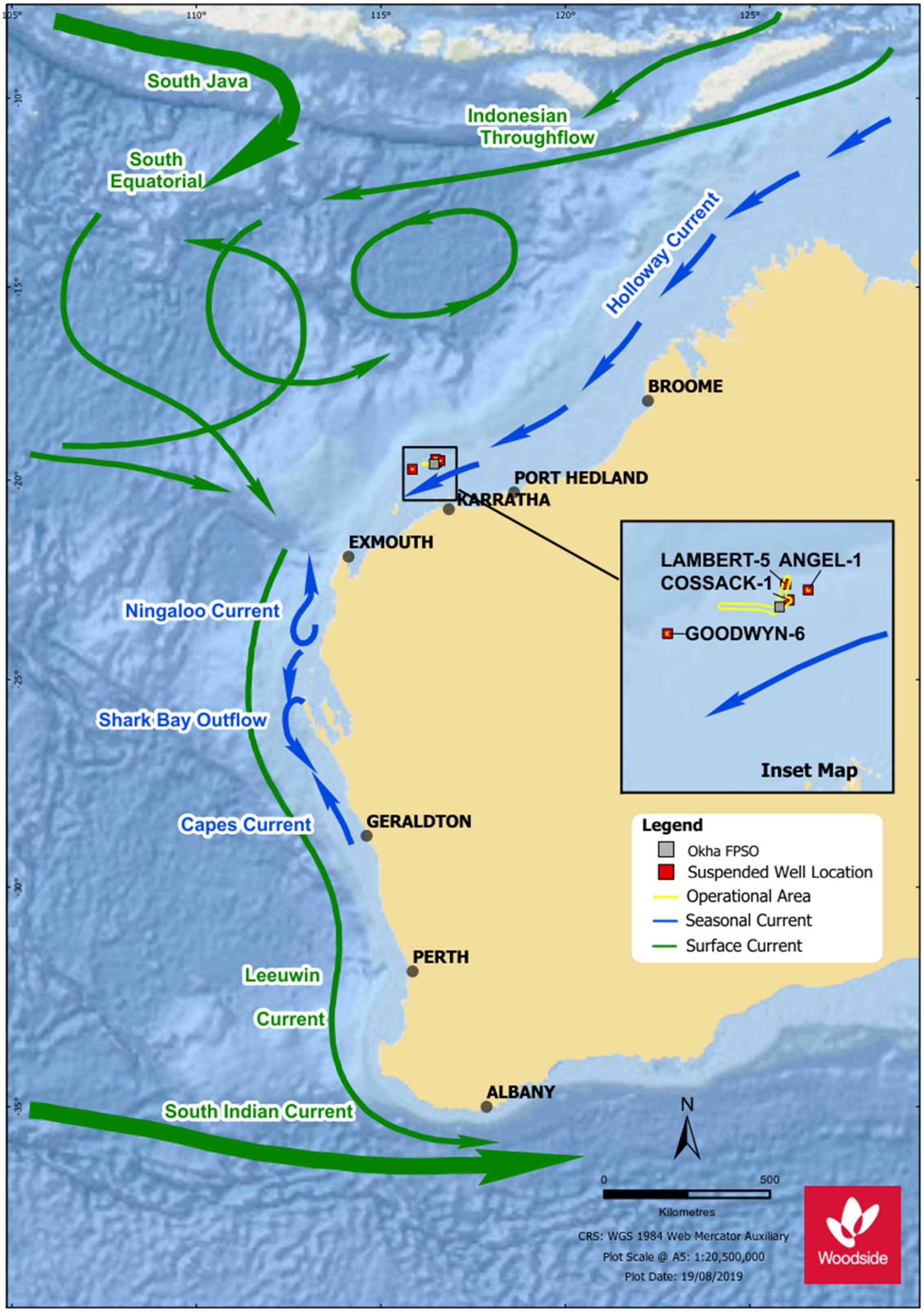

Figure 4-6: Large-scale ocean circulation of the NWMR including the location of the ITF and other currents of significance

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

4.4.2.2 Wave Height

Datawell waverider buoys measured wave height from 1993 to 2005 near the Pluto platform (~92 km south-west of the Operational Area), recording a maximum measured non-cyclonic significant wave height of 6.2 m and a combined non-cyclonic and cyclonic maximum wave height of 11.4 m.

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

4.4.2.3 Seawater Characteristics

The offshore, oceanic seawater characteristics of the NWS Province exhibit seasonal and water depth variation in temperature and salinity, greatly influenced by major currents in the region (see Section 4.4.2). Surface waters are relatively warm year round due to the tropical water supplied by the ITF and the Leeuwin Current, with temperatures reaching 30 °C in summer and dropping to 22 °C in winter (Pearce et al. 2003). Seawater temperature records taken from within the region of the Operational Area from December 2005 to January 2007 show surface waters reach their maximum average temperatures in March and April (average ~28.5 °C) and are coolest in August, September and October (average ~24.3 °C) (BMT Oceanica 2015a, Woodside Energy 2006). Near seabed temperatures in deeper waters (>120 m water depth) are less variable, with temperatures averaging 22–24 °C year round.

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

Variation in surface salinity along the NWS (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 run-off, wind-generated waves and large tidal ranges (Pearce et al. 2003). Periodic events, such as major sediment transport associated with tropical cyclones, may influence turbidity on a regional scale (Brewer et al. 2007).

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

4.4.3 Bathymetry

The Operational Area lies in waters ~75 to 130 m deep on the continental shelf (Figure 4-6). The bathymetry within the Operational Area is generally flat, which is consistent with the broader NWS Province shelf region (Baker et al. 2008). The seabed has a gentle (0.05°) seaward gradient, extending to a relatively steep outer slope ~200 to 300 km offshore in water depths of around 200 m (Dix et al. 2005). The continental slope then descends more rapidly from the shelf edge to depths >1000 m to the north-west (James et al. 2004).

A section of the Ancient Coastline at 125 m Depth Contour KEF overlaps the Operational Area. Areas of this KEF comprise rocky hard substrate, which may occur within the Operational Area; however, the portion of the KEF that overlaps the Operational Area is predominantly made up of soft sediment.

Glomar Shoal is a shallow sedimentary bank comprising coarser biogenic material than the surrounding seabed and has been defined as a KEF within the NWMR. The shoal reaches to within 26–70 m of the sea surface (Falkner et al. 2009) and is ~3 km south-east of the Operational Area at the nearest point (i.e. from the Angel-1 suspended exploration well section of the Operational Area) and ~14 km from the Okha FPSO.

Rankin Bank is a sedimentary bank located on the continental shelf ~21 km east of the Operational Area at the nearest point (i.e. from the Goodwyn-6 suspended exploration well section of the Operational Area) and ~87 km from the Okha FPSO. The bank rises from around 40–50 m to 18 m from the sea surface.

Refer to Section 4.7 for information on the environmental values of Rankin Bank and Glomar Shoal.

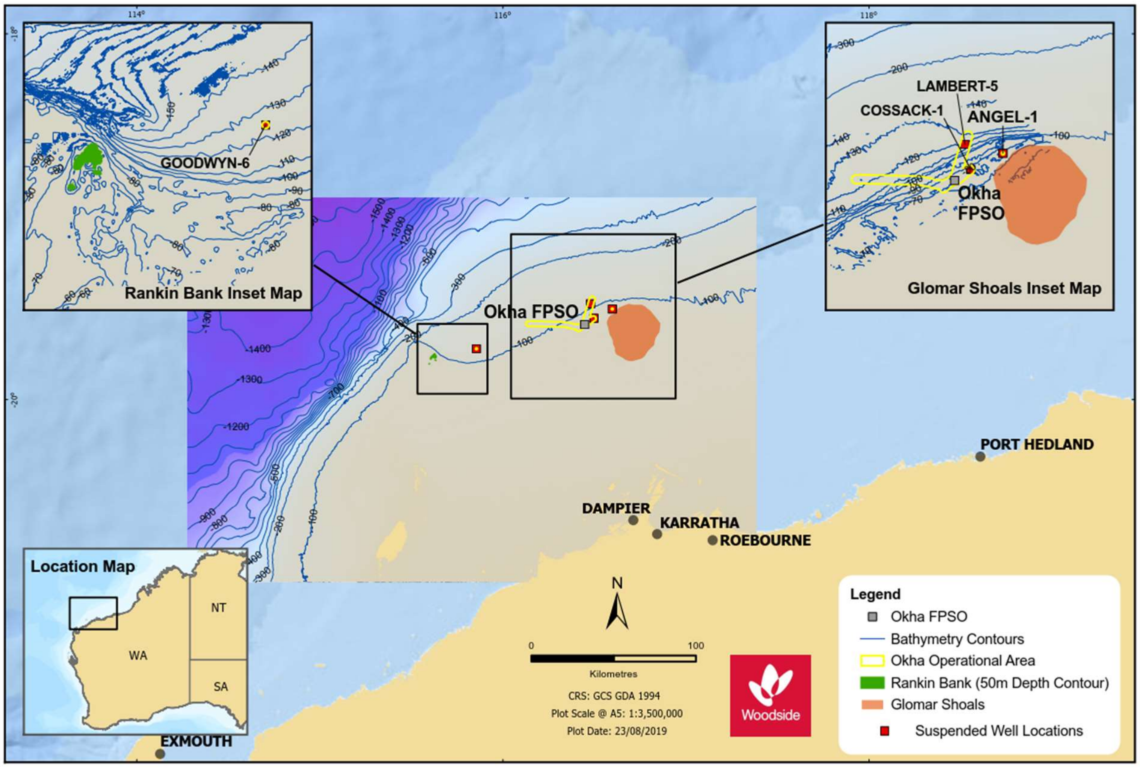

Figure 4-7: Bathymetry and seabed features of the Operational Area

4.4.4 Marine Sediment

Sediments in the Operational Area are expected to be broadly consistent with those in the NWS Province, and can be inferred from Woodside sampling programs undertaken at Glomar Shoal and the GWA (Australian Institute of Marine Science [AIMS] 2014a, BMT Oceanica 2015a). The sediments in the Operational Area are expected to comprise primarily fine sands, very fine sands and silt, similar to those analysed at Glomar Shoal and GWA, ~3 km and 22 km from the Operational Area at the closest points, respectively (AIMS 2014a, BMT Oceanica 2015a).

Sediments in the outer NWS Province are relatively homogenous and are typically dominated by sands and a small portion of gravel (Baker et al. 2008). Fine sediments (e.g. muds) increase with proximity to the shoreline and the shelf break but are less prominent in the intervening continental shelf (Baker et al. 2008). Carbonate sediments typically account for the bulk of sediment composition, with both biogenic and precipitated sediments present on the outer shelf (Dix et al. 2005). Beyond the shelf break, the proportion of fine sediments increases along the continental slope towards the Exmouth Plateau and the abyssal plain (Baker et al. 2008).

While hard substrates are not known to occur within the Operational Area, they occur in the region more broadly and can host more diverse benthic communities. Hard substrate may be associated with the Ancient Coastline at 125 m Depth Contour KEF (Section 4.7.6).

4.4.5 Air Quality

There is a lack of air quality data for the offshore NWMR airshed. 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, Woodside considers that the ambient air quality in the Operational Area and wider offshore NWMR will be high.

4.5 Biological Environment

4.5.1 Habitats

4.5.1.1 Critical Habitat – EPBC Listed

No Critical Habitats or Threatened Ecological Communities, as listed under the EPBC Act, occur within the Operational Area, as indicated by the EPBC Act PMST report based on the Operational Area and wider EMBA, which is provided in Appendix C.

4.5.1.2 Marine Primary Producers

Seafloor communities in deeper shelf waters receive insufficient light to sustain ecologically sensitive primary producers such as seagrasses, macroalgae or zooxanthellate corals. These benthic primary producer groups will not occur in the Operational Area given the depth of water (between ~75 and 130 m).

Benthic primary producer habitats are widespread within the EMBA in relatively shallow waters (typically <30 m water depth), such as the mainland coast, offshore islands, reefs and sedimentary banks.

Coral Reef

Coral reef habitats are an integral part of the marine environment; these habitats have a high diversity of corals, associated fish and other species of both commercial and conservation importance. Coral communities on the middle to outer continental shelf in the region are typically mesophotic and hence are restricted to benthic habitats receiving sufficient photosynthetically active radiation (PAR) to support zooxanthellate corals (Wahab et al. 2018). Turbidity strongly influences PAR reaching the seabed, with less-turbid areas supporting zooxanthellate corals to greater depths (Wahab et al. 2018). Notable coral habitat within the wider EMBA includes, but is not limited to (approximate distance and direction from the closest point of the Operational Area in brackets):

- Glomar Shoal (3 km south-east to KEF boundary)
- Rankin Bank (21 km east)
- Dampier Archipelago (90 km south to State National Heritage Place)
- Montebello Island group (73 km south-west to State Marine Park)
- Barrow Island and Lowendal Island group (94 km south-west to Marine Management Area)
- Ningaloo Coast (incl. Muiron Islands) (259 km south-west to WHA)
- Rowley Shoals (317 km to nearest State Marine Park).

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

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 environmentally sensitive locations with coral reef habitats is provided in Section 4.7.

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 WA, these habitats are restricted to sheltered and shallow waters due to large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones. Seagrass beds and macroalgae habitats are widely distributed in shallow coastal waters in the wider EMBA that receive sufficient light. Further information on locations with seagrass and macroalgae habitats is provided in Section 4.7.

Mangroves

Mangroves 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, nutrients and water quality within coastal environments, and reduce coastal erosion. The closest coastal habitats to the Operational Area are found 73 km south-west at the Montebello Islands. Mangroves are located in the wider EMBA on offshore islands (Montebello Islands, Barrow Island) and sections of the coastline including large extents of the Pilbara mainland coast (outside the EMBA) and isolated sections of the Ningaloo Coast. Further information on sensitive locations with mangroves is provided in Section 4.7.

4.5.1.3 Lifecycle Stages and 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 Area, as identified by the EPBC Act PMST (Appendix C), is outlined below in Section 4.5.2 within the relevant species sections, or within Section 4.7.

Migration Corridors

Many marine species, including cetaceans, whale sharks, and migratory seabirds and shorebirds, migrate seasonally between feeding, breeding and nursery habitats through the use of migration corridors. Any migration corridor for a protected species that passes through or close to the Operational Area, or within other nearby areas (including the EMBA), is outlined in Section 4.5.2. within the relevant species and BIA subsections.

4.5.1.4 Other Communities/Habitats

Plankton

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

Within the wider EMBA, peak primary productivity occurs in late summer/early autumn, along the shelf edge of Ningaloo Reef. This peak primary productivity period 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 Area and the EMBA) comprise small and large pelagic and 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.

Similar to survey findings at GWA, the presence of subsea infrastructure associated with the Okha FPSO has likely resulted in the development of demersal fish communities that would otherwise not occur in the Operational Area (McLean et al. 2017). The type and abundance of fish present is expected to be highly variable and depend on the relative position of infrastructure on the seabed. For example, partially buried pipelines do not appear to provide the same habitat complexity and opportunity that suspended or resting pipelines provide (McLean et al. 2017). Fish assemblages and colonising invertebrate habitats on artificial hard substrates have also been found to vary with depth and age of the infrastructure. Generally, the structures located in shallower water (<135 m) had a greater diversity of fish compared to habitats at 350 m depth, where the number of fish species and abundance declined markedly (McLean et al. 2018). A study by Bond et al. (2018) confirmed that, compared to adjacent natural seabed habitats, fish fauna associated with pipelines were characterised by higher relative abundance and biomass of commercially important species.

Given the Operational Area is within continental shelf waters, pelagic species are expected to be present. The Ancient Coastline at 125 m Depth Contour KEF overlaps a small portion of the Operational Area, and includes areas of hard substrate that may support relatively diverse demersal fish assemblages. The Glomar Shoal KEF and Rankin Bank (3 km south-east and 21 km east of the Operational Area, respectively) have also been identified as supporting high demersal fish richness and abundance (Wahab et al. 2018). The Continental Slope Demersal Fish Communities KEF is located ~40 km west of the Operational Area at the closest point. Further information on these KEFs, Rankin Bank and Glomar Shoal is provided in Section 4.7.

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). Filter feeders generally live in areas that have strong currents and hard substratum and are closely associated with substrate type, with areas of hard substrate typically supporting more diverse epibenthic communities (Heyward et al. 2001). Filter feeder communities within the Operational Area are expected to be associated with areas of hard substrate, including development infrastructure, and which may also occur within areas of the Glomar Shoal and Ancient Coastline at the 125 m Depth Contour KEFs where there is hard substrate for attachment.

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

Sponges and mixed sponge benthic groups were the dominant benthic group at Glomar Shoal, with hard corals, algae, soft corals and mixed benthos only making up 10% of the study area (AIMS 2014b). In contrast, Rankin Bank has almost equal areas of hard corals, soft corals and sponges (AIMS 2014b). The study indicated that both areas had characteristic transitions in habitat types with depth, from shallow hard coral and associated algae groups to deeper soft coral areas with sponges (AIMS 2014b).

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

Discrete areas of hard substrate hosting sessile filter-feeding communities may be associated with the Ancient Coastline at the 125 m Depth Contour KEF, which overlaps the Operational Area. Falkner et al. (2009) concluded the Ancient Coastline may not represent different habitat type compared to the surrounding areas and suggested that associated faunal communities may be similar.

The Montebello AMP is located ~35 km south-west of the Operational Area (within the EMBA). Recent and historical surveys have identified this AMP as comprising mainly a flat bottom topography with variable benthic filter feeder communities. In a 2017 survey, filter feeder communities were dominated by hydroids, sea pens and crinoids, with low numbers of sponges, whips and gorgonians (Keesing 2019). A total of 76 sponge species were identified within the Montebello AMP during the 2017 survey, with most of these species occurring within shallow areas of the AMP (Keesing 2019).

Within the wider 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).

Other Benthic Communities

Woodside has collected numerous biological grab samples of the unconsolidated seabed sediments at the NRC and the surrounding area, as well as additional sampling throughout the broader region (Heyward et al. 2001, SKM 2007a). Studies have revealed that infauna associated with soft unconsolidated sediment habitat in the area of the NWS Province is widespread and well represented along the continental shelf and upper slopes (Brewer et al. 2007, LeProvost Dames & Moore 2000, Rainer 1991, RPS 2012, SKM 2007a, Woodside Energy 2005).

4.5.2 Species

4.5.2.1 Protected Species

The EPBC Act PMST has been used to identify listed species that may occur within and adjacent to the Operational Area and the wider EMBA; this informs the assessment of planned events as well as unplanned events in Sections 6.6, 6.7, and 6.8. EPBC Act PMST reports were generated to identify MNES within the Operational Area and the EMBA for the worst-case loss of well containment scenario (this encompasses the different hydrocarbon fates for all credible hydrocarbon spill scenarios). Note: The EPBC Act PMST is a general database that conservatively identifies areas in which protected species have the potential to occur.

A total of 61 EPBC Act listed species (28 threatened species and 53 migratory species) considered to be MNES were identified as potentially occurring within the wider EMBA, of which a subset of 32 species were identified as potentially occurring within the Operational Area (Table 4-4). The full list of marine species identified from the PMST is provided in Appendix C. Note: Several MNES that are not considered to be credibly impacted (e.g. terrestrial species within the wider EMBA) were identified by the EPBC Act PMST reports, and were excluded from further consideration (see Appendix C for the list of these species and their justification for exclusion). One additional fish species (southern bluefin tuna) and one additional shark species (scalloped hammerhead), which are Conservation Dependent under the EPBC Act but are not currently included in the EPBC Act PMST, were found within the EMBA. These species are described in Section 4.5.2.7.

Table 4-3: Species identified by the EPBC Act Protected Matters search as potentially occurring within or using habitat in the Operational Area and/or EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Mammals					
Balaenoptera borealis	Sei Whale	Vulnerable	Migratory	Yes (Y)	Y
Balaenoptera musculus	Blue Whale	Endangered	Migratory	Y	Y
Balaenoptera physalus	Fin Whale	Vulnerable	Migratory	Y	Y
Megaptera novaeangliae	Humpback Whale	Vulnerable	Migratory	Y	Y
Balaenoptera edeni	Bryde's Whale	Not applicable (N/A)	Migratory	Y	Y
Orcinus orca	Killer Whale	N/A	Migratory	Y	Y
Physeter macrocephalus	Sperm Whale	N/A	Migratory	Y	Y
Tursiops aduncus	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	N/A	Migratory	Y	Y
Sousa chinensis	Indo-Pacific Humpback Dolphin	N/A	Migratory	N/A	Y
Eubalaena australis	Southern Right Whale	Endangered	Migratory	N/A	Y
Balaenoptera bonaerensis	Antarctic Minke Whale	N/A	Migratory	N/A	Y
Dugong dugon	Dugong	N/A	Migratory	N/A	Y
Reptiles					
Caretta caretta	Loggerhead Turtle	Endangered	Migratory	Y	Y
Chelonia mydas	Green Turtle	Vulnerable	Migratory	Y	Y
Dermochelys coriacea	Leatherback Turtle	Endangered	Migratory	Y	Y
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable	Migratory	Y	Y
Natator depressus	Flatback Turtle	Vulnerable	Migratory	Y	Y
Aipysurus apraefrontalis	Short-nosed Sea snake	Critically Endangered	N/A	N/A	Y
Fishes and Elasmobranchs					
Carcharias taurus	Grey Nurse Shark (west coast population)	Vulnerable	N/A	Y	Y
Carcharodon carcharias	Great White Shark	Vulnerable	Migratory	Y	Y

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Pristis zijsron	Green Sawfish	Vulnerable	Migratory	Y	Y
Rhincodon typus	Whale Shark	Vulnerable	Migratory	Y	Y
Anoxypristis cuspidata	Narrow Sawfish	N/A	Migratory	Y	Y
Isurus oxyrinchus	Shortfin Mako	N/A	Migratory	Y	Y
Isurus paucus	Longfin Mako	N/A	Migratory	Y	Y
Manta alfredi	Reef Manta Ray	N/A	Migratory	Y	Y
Manta birostris	Giant Manta Ray	N/A	Migratory	Y	Y
Pristis clavata	Dwarf Sawfish	Vulnerable	Migratory	N/A	Y
Lamna nasus	Porbeagle, Mackerel Shark	N/A	Migratory	N/A	Y
Birds					
Calidris canutus	Red Knot, Knot	Endangered	Migratory	Y	Y
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Critically Endangered	Migratory	Y	Y
Anous stolidus	Common Noddy	N/A	Migratory	Y	Y
Calonectris leucomelas	Streaked Shearwater	N/A	Migratory	Y	Y
Fregata ariel	Lesser Frigatebird	N/A	Migratory	Y	Y
Fregata minor	Great Frigatebird	N/A	Migratory	Y	Y
Actitis hypoleucos	Common Sandpiper	N/A	Migratory	Y	Y
Calidris acuminata	Sharp-tailed Sandpiper	N/A	Migratory	Y	Y
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory	Y	Y
Pandion haliaetus	Osprey	N/A	Migratory	Y	Y
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory	N/A	Y
Limosa lapponica baueri	Bar-tailed Godwit	Vulnerable	Migratory	N/A	Y
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically Endangered	N/A[1]	N/A	Y
Macronectes giganteus	Southern Giant-Petrel	Endangered	Migratory	N/A	Y

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Malurus leucopterus edouardi	White-winged Fairy-wren	Vulnerable	N/A	N/A	Y
Papasula abbotti	Abbott's Booby	Endangered	N/A	N/A	Y
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	N/A	N/A	Y
Sternula nereis	Australian Fairy Tern	Vulnerable	N/A	N/A	Y
Thalassarche impavida	Campbell Albatross	Vulnerable	Migratory	N/A	Y
Rostratula australis	Australian Painted-snipe	Endangered	N/A	N/A	Y
Apus pacificus	Fork-tailed Swift	N/A	Migratory	N/A	Y
Ardenna carneipes	Flesh-footed Shearwater	N/A	Migratory	N/A	Y
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory	N/A	Y
Hydroprogne caspia	Caspian Tern	N/A	Migratory	N/A	Y
Onychoprion anaethetus	Bridled Tern	N/A	Migratory	N/A	Y
Phaethon lepturus	White-tailed Tropicbird	N/A	Migratory	N/A	Y
Sterna dougallii	Roseate Tern	N/A	Migratory	N/A	Y
Sternula albifrons	Little Tern	N/A	Migratory	N/A	Y
Charadrius veredus	Oriental Plover	N/A	Migratory	N/A	Y
Glareola maldivarum	Oriental Pratincole	N/A	Migratory	N/A	Y
Thalasseus bergii	Crested Tern	N/A	Migratory	N/A	Y
Tringa nebularia	Common Greenshank	N/A	Migratory	N/A	Y

** Listed as migratory at the species level*

4.5.2.2 Listed Threatened Species Recovery Plans

The requirements of the species recovery plans and conservation advices (Table 4-4) were considered to identify any aspects that may be applicable to the risk assessment (Section 5). Recovery plans are enacted under the EPBC Act and remain in force until the species is removed from the threatened list. Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to conserve a listed species or ecological community.

Table 4-4 outlines the recovery plans and conservation advice relevant to those species identified as potentially occurring within or using habitat in the Operational Area and EMBA by the EPBC Act PMST (Appendix C), and summarises the key threats to those species, as described in relevant recovery plans and conservation advices.

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

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
All Vertebrate Fauna				
All vertebrate fauna	Threat abatement plan for the impacts of marine debris on vertebrate marine life (DoEE 2018)	Marine debris	No explicit management actions for non–fisheries-related industries (note that management actions in the plan relate largely to management of fishing waste (e.g. 'ghost' gear), and State and Commonwealth management through regulation)	6.7.2
Marine Mammals				
Sei whale	Conservation advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee 2015a)	Noise interference	Assess and manage acoustic disturbance	6.6.3
		Vessel disturbance	Assess and manage physical disturbance and development activities	6.7.3
Blue whale	Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015–2025 (Commonwealth of Australia 2015)	Noise interference	Assess and address anthropogenic noise	6.6.3
		Vessel disturbance	Minimise vessel collisions	6.7.3
Fin whale	Approved conservation advice for *Balaenoptera physalus* (fin whale) (Threatened Species Scientific Committee 2015b)	Noise interference	Assess and address anthropogenic noise	6.6.3
		Vessel disturbance	Minimise vessel collisions	6.7.3
Humpback whale	Approved conservation advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee 2015c)	Noise interference	For actions involving acoustic impacts (e.g. pile driving, explosives) on humpback whale calving, resting, feeding area, or confined migratory pathways, site-specific acoustic modelling should be undertaken (including cumulative noise impacts)	6.6.3
		Vessel disturbance	Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required, implement appropriate mitigation measures to reduce the risk of vessel strike	6.7.3
		Noise interference	Assess and address anthropogenic noise	6.6.3

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
Southern right whale	Conservation management plan for the southern right whale: a recovery plan under the EPBC Act 1999 2011–2021 (DSEWPaC 2012b)	Vessel disturbance	Minimise vessel collisions	6.7.3
Reptiles				
All marine turtle species (loggerhead, green, leatherback, hawksbill, flatback)	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017)	Chemical and terrestrial discharge (oil pollution)	Ensure spill risk strategies and response programs include management for marine turtles and their habitats	Appendix D
		Light pollution	Minimise light pollution	6.8.3 to 6.8.9
		Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat	6.7.3
		Noise interference	No explicit relevant management actions; vessel strikes identified as a threat	6.6.3
Leatherback turtle	Approved conservation advice on *Dermochelys coriacea* (Threatened Species Scientific Committee 2008a)	Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat	6.7.3
Short-nosed sea snake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (Department of the Environment 2013a)	No additional threats identified (excl. marine debris)	None applicable	N/A
Sharks and Rays				
Grey nurse shark (west coast population)	Recovery plan for the grey nurse shark (*Carcharias taurus*) (Department of the Environment 2014)	No additional threats identified (excl. marine debris)	None applicable	N/A
White shark	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013b)	No additional threats identified (excl. marine debris)	None applicable	N/A
All sawfish (green, dwarf, freshwater)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	6.8.3 to 6.8.9

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
Green sawfish	Approved conservation advice for green sawfish (Threatened Species Scientific Committee 2008b)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	6.8.3 to 6.8.9
Dwarf sawfish	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (Threatened Species Scientific Committee 2009)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	6.8.3 to 6.8.9
Whale shark	Approved Conservation Advice for *Rhincodon typus* (whale shark) (Threatened Species Scientific Committee 2015d)	Vessel disturbance	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations, and along the northward migration route that follows the northern WA coastline along the 200 m isobaths	6.7.3
	Whale shark (*Rhincodon typus*) recovery plan 2005–2010[4] (Department of the Environment and Heritage [DEH] 2005a)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	6.8.3 to 6.8.9
Birds				
Migratory shorebird species	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c)	Habitat degradation/ modification	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes	6.8.3 to 6.8.9
Curlew sandpiper	Conservation advice *Calidris ferruginea* curlew sandpiper (Threatened Species Scientific Committee 2015f)	Habitat loss and degradation from pollution	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment process	6.8.3 to 6.8.9
Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (Threatened Species Scientific Committee 2016a)	Pollution/contamination	No explicit relevant management actions; pollution identified as a threat	6.8.3 to 6.8.9
Bar-tailed godwit (baueri)	Conservation advice *Limosa lapponica baueri* bar-tailed godwit (western Alaskan) (Threatened Species Scientific Committee 2016d)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	6.8.3 to 6.8.9

[4] The Whale shark (*Rhincodon typus*) recovery plan ceased to be in effect on 1 October 2015; however, the conservation advice in this plan was considered to inform the context of the environmental risk assessment for the Petroleum Activities Program.

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
Albatrosses and giant petrels (southern giant-petrel)	National recovery plan for threatened albatrosses and giant petrels (DSEWPaC 2011)	Marine pollution	No explicit relevant management actions; pollution identified as a threat	6.8.3 to 6.8.9
Northern Siberian bar-tailed godwit	Conservation advice *Limosa lapponica menzbieri* bar-tailed godwit (northern Siberian) (Threatened Species Scientific Committee 2016e)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	6.8.3 to 6.8.9
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (Threatened Species Scientific Committee 2015g)	Habitat loss and degradation from pollution	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment process	6.8.3 to 6.8.9
Abbott's booby	Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee 2015h)	No additional threats identified (ex. marine debris)	None applicable	N/A
Soft-plumaged petrel	Conservation advice *Pterodroma mollis* soft-plumage petrel (Threatened Species Scientific Committee 2015i)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	N/A
Australian fairy tern	Conservation advice for *Sterna nereis* (Fairy tern) (Threatened Species Scientific Committee 2011)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	6.8.3 to 6.8.9
White-winged fairy-wren	Conservation advice for *Malurus leucopterus edouardi* (White-winged Fairy-wren (Barrow Island)) (Threatened Species Scientific Committee 2008)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	6.8.3 to 6.8.9

4.5.2.3 Biologically Important Areas

A review of the DoEE National Conservation Values Atlas identified that these BIAs overlap spatially with the Operational Area:

- foraging area for the wedge-tailed shearwater during its breeding season (August–April)
- foraging area for whale sharks northward from Ningaloo Reef along the 200 m isobath, with seasonally high use (April to June)
- internesting BIA for flatback turtles around the Montebello Islands (Hermite Islands, Northwest Island and Trimouille Island) (nesting between December to March).

Several BIAs occur within the wider EMBA, as listed in Table 4-5. Additional information on BIAs is provided in the species-specific summaries in Section 4.5.2.

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

Species	BIA Type (location)	Distance from Operational Area (km)
Marine Mammals		
Pygmy blue whale	Migration (Augusta to Derby along the shelf edge)	38
	Foraging (Ningaloo)	308
Dugong	Calving (Ningaloo)	261
	Breeding (Ningaloo)	261
	Nursing (Ningaloo)	261
	Foraging (Ningaloo)	261
Humpback whale	Migration (north and south)	29
	Resting (Exmouth Gulf)	272
Marine Reptiles		
Loggerhead turtle	Internesting (Cohen Island[1] and Rosemary Island in the Dampier Archipelago, Montebello Islands)	71
	Nesting[2] (Cohen Island[1], Exmouth Gulf and Ningaloo coast)	93
Green turtle	Internesting (Dampier Archipelago[1], Montebello Islands, Barrow Island)	75
	Nesting[2] (Dampier Archipelago[1], Montebello Islands, Barrow Island, Muiron Islands, and North West Cape/Exmouth Gulf and Ningaloo coast)	75
	Foraging (Montebello Islands[1], Barrow Island)	51
	Mating (Montebello Islands[1], Barrow Island)	51
	Aggregation (Montebello Islands)	51
	Basking (Barrow Island)	110
Hawksbill turtle	Internesting (Dampier Archipelago[1], Montebello Islands, Lowendal Islands, Barrow Island, Thevenard Island, Ningaloo coast and Jurabi coast)	73
	Nesting[2] (Dampier Archipelago[1], Montebello Islands, Lowendal Islands, Thevenard Island, Barrow Island, Thevenard Island, Ningaloo coast and Jurabi coast)	73
	Mating (Montebello Islands[1], Lowendal Islands, Barrow Island)	75
	Foraging (Lowendal Islands[1], Barrow Island)	75

Species	BIA Type (location)	Distance from Operational Area (km)
Flatback turtle	Internesting (Montebello Islands[1], Dampier Archipelago, Barrow Island, Thevenard Island, Ningaloo coast and Jurabi coast)	Overlapping[3]
	Nesting[2] (Dampier Archipelago[1], Montebello Islands, Barrow Island, Thevenard Island – south coast)	32
	Foraging (Montebello Islands[1], Barrow Island)	75
	Mating (Montebello Islands[1], Barrow Island)	75
	Aggregation (Montebello Islands)	75
Sharks, Fish and Rays		
Whale shark	Foraging (northward from Ningaloo along 200 m isobath)	Overlapping
	Foraging (Ningaloo Marine Park)	301
Birds		
Australian Fairy tern	Breeding (Pilbara and Gascoyne coast and islands[1])	70
Roseate tern	Breeding (Pilbara and Gascoyne coast and islands[1])	68
Wedge-tailed shearwater	Breeding (Pilbara and Gascoyne coast and islands[1])	Overlapping
Lesser crested tern	Breeding (Pilbara and Gascoyne coast and islands[1])	76
Lesser frigatebird	Breeding (Pilbara and Gascoyne coast and islands)	167
White-tailed tropicbird	Breeding (Rowley Shoals)	219
Little tern	Breeding (Rowley Shoals)	363

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

[2] Identified as habitat critical to the survival of the species in the Recovery Plan for Marine Turtles in Australia 2017–2027 (Commonwealth of Australia, 2017). Note: These defined areas include internesting habitat, and therefore the distances to actual nesting beaches will be greater.

[3] BIA overlaps the Goodwyn-6 suspended exploration well section of the Operational Area only and is ~18 km from the Okha FPSO.

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

4.5.2.4 Seasonal Sensitivities of Protected Species

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

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

Species	January	February	March	April	May	June	July	August	September	October	November	December
Humpback whale – northern migration (Jurien Bay to Montebello)[1]												
Humpback whale – southern migration (Jurien Bay to Montebello)[2]												
Blue whale – northern migration (Exmouth, Montebello, Scott reef)[2]												
Blue whale – southern migration (Exmouth, Montebello, Scott Reef)[2]												
Sperm whale[5]												
Green turtle[6]												
Flatback turtle[7]												
Loggerhead turtle[8]												
Hawksbill turtle[9]												
Whale shark* – foraging/aggregation near Ningaloo[10]												
Manta ray – presence/aggregation/breeding Ningaloo[11]												
Australian fairy tern – breeding Ningaloo[10]												
Caspian tern – breeding Ningaloo[10]												
Crested tern – breeding Ningaloo[10]												
Osprey – breeding Ningaloo[10]												
Roseate tern – breeding Ningaloo[10]												
Wedge-tailed shearwater – various breeding sites within EMBA[12]												
Migratory shorebirds[13]												

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

References for species seasonal sensitivities:

1. *Environment Australia 2002, Jenner et al. 2001*
2. *DSEWPaC 2012a, McCauley and Jenner 2010*
3. *McCauley 2011*
4. *Department of Environmental Protection 2001*
5. *National Marine Fisheries Services 2006, Whitehead 2002a*
6. *Commonwealth of Australia 2017, CALM 2005, DSEWPaC 2012a*
7. *Commonwealth of Australia 2017, DSEWPaC 2012a*
8. *Commonwealth of Australia 2017, CALM 2005*
9. *Commonwealth of Australia 2017*
10. *CALM 2005, Environment Australia 2002*
11. *Environment Australia 2002*
12. *DSEWPaC 2012c, Environment Australia 2002*
13. *Bamford et al. 2008*

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

4.5.2.5 Marine Mammals

Cetaceans – Whales

Sei Whale

Sei whales were identified as potentially occurring within the Operational Area and wider EMBA. Sei whales have a worldwide oceanic distribution and are expected to migrate seasonally between low-latitude wintering areas and high-latitude summer feeding grounds (Bannister et al. 1996, Prieto et al. 2012). Sei whales have been infrequently recorded in Australian waters (Bannister et al. 1996); however, these recordings may be incorrect as sei whales and Bryde's whales have a similar appearance. There are no known mating or calving areas in Australian waters (DoEE 2017). Although sei whales have been sighted inshore (near the Bonney Upwelling in Victoria), they prefer deep waters and typically occur in oceanic basins and continental slopes (Prieto et al. 2012). Neither the Operational Area nor wider EMBA are considered critical habitat for sei whales. Sei whales are likely to occur within the Operational Area, but their presence is likely to be rare and limited to a few individuals infrequently transiting the area.

Bryde's Whale

The Bryde's whale was identified as potentially occurring within the Operational Area and wider EMBA. The Bryde's whale occurs in tropical and temperate waters (Bannister et al. 1996, DoEE 2015). Bryde's whales occur in both oceanic and inshore waters, with the only key localities recognised in WA being the Abrolhos Islands (outside the EMBA) and north of Shark Bay (Bannister et al. 1996). Two forms are recognised: inshore (largely sedentary) and offshore (may undertake migration). Data suggests offshore whales may migrate seasonally, heading towards warmer tropical waters during the winter; however, information on migration is not well known (McCauley and Duncan 2011). There is some taxonomic confusion, with Bryde's whales bearing similarity to, and historically confused with, the sei whale (Bannister et al. 1996a), particularly in whaling catch statistics (Slijper et al. 1964).

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

Blue Whale

Blue whales were identified as potentially occurring within the Operational Area and wider EMBA. 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 2015). 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) (DEH 2005b). On this basis, nearly all blue whales sighted in the NWMR are likely to be pygmy blue whales.

Pygmy blue whales are known to migrate seasonally 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 (i.e. west of the Operational Area). They are likely to feed opportunistically on ephemeral krill aggregations (DEWHA 2008). Sea noise loggers and satellite tracking at various locations along the WA coast have detected an annual northbound migration past Exmouth and the Montebello Islands between April and August, and southbound migration from October to the end of January, peaking in late November to early December (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 >200 m and commonly >1000 m (Double et al. 2012b) (Figure 4-8). These data showed that whales tagged during March and April migrated northwards after 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 2015) has delineated the distribution area of blue whales in Australian waters and identified a number of BIAs for blue whales in the waters off WA (migratory corridor and foraging areas). The plan also documents that the pygmy blue whales that feed off the Perth Canyon in WA and those that feed within the Bonney Upwelling in South Australia (SA) and Victoria are from the same population. The migration BIA off the WA coast is ~38 km north of the Operational Area at the closest point and within the wider EMBA. Based on pygmy blue whale migration timing, the species may occur in the wider EMBA between April and August (northbound migration) and October to January (southbound migration). A possible foraging BIA is off the Ningaloo Coast (~308 km south-west of the Operational Area at the closest point, but within the wider EMBA), within which pygmy blue whales may feed (Double et al. 2014).

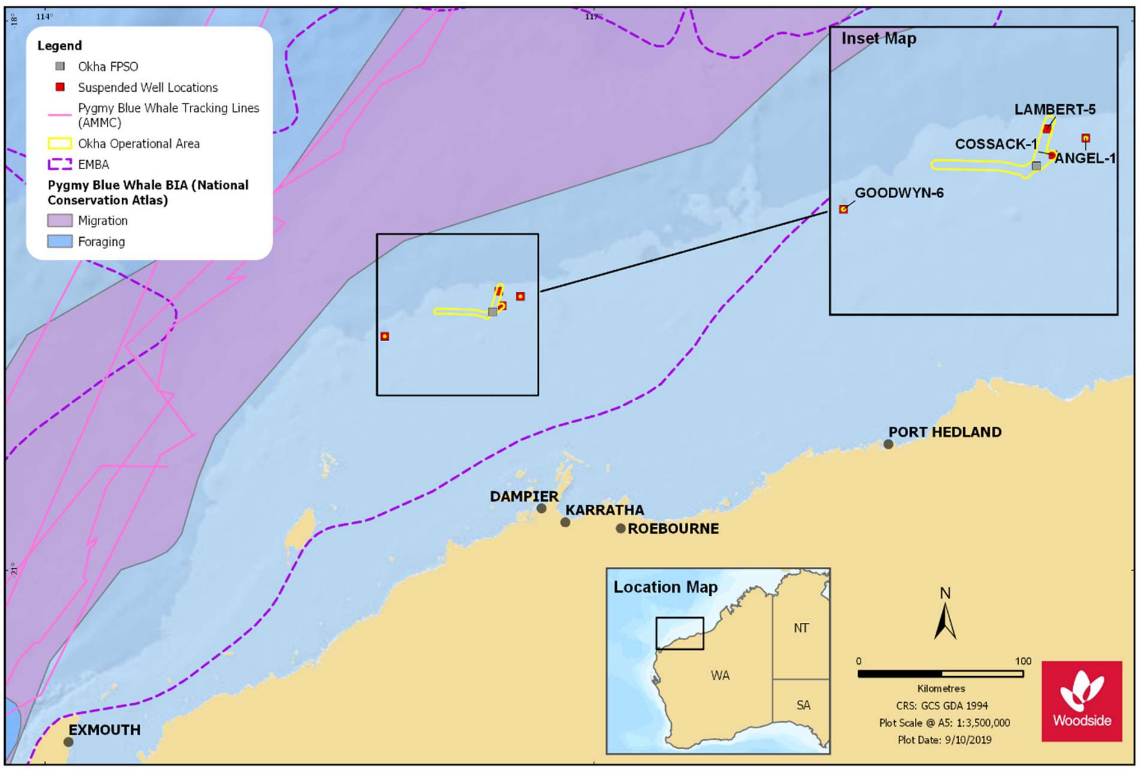

Figure 4-8: Pygmy blue whale satellite tracks and BIAs

Source: Double et al. 2012b, 2014

Fin Whale

Fin whales were identified as potentially occurring within the Operational Area and wider EMBA. The fin whale is the second largest species after the blue whale. 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 rarely encountered in coastal or continental shelf waters. The Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving areas in Australian waters (Morrice et al. 2004). There are also no known BIAs for fin whales in the NWMR. As such, the species may be encountered within the Operational Area, and is expected to occur in the wider EMBA, particularly in oceanic and continental slope waters.

Humpback Whale

Humpback whales were identified as occurring within the Operational Area and wider EMBA. The species regularly migrates seasonally between feeding grounds in the Southern Ocean and breeding and calving grounds off northern WA, particularly Camden Sound (Jenner et al. 2001). Calving typically occurs at the northern extent of the migration corridor (beyond the wider EMBA).

Woodside has conducted marine megafauna aerial surveys that have confirmed the temporal distribution of migrating humpback whales off North West Cape has remained consistent since baseline surveys were first conducted in 2000–2001 (RPS Environment and Planning 2010a). Most whales occurred in depths <500 m, with the greatest density of whales concentrated in water depths of 200–300 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. 2010, 2012a) (Figure 4-9).

From North West Cape, northbound humpback whales travel along the edge of the continental shelf passing west of the Muiron, Barrow and Montebello Islands (Figure 4-9), peaking in late July (Jenner et al. 2001). The southern migratory route follows a relatively narrow track between the Dampier Archipelago and Montebello Islands. The humpback migration BIA is ~29 km from the Operational Area. Exmouth Gulf and Shark Bay are known resting/aggregation areas for southbound humpback whales. In particular, Exmouth Gulf is where cow/calf pairs may stay for up to two weeks during September (Jenner et al. 2001). The Exmouth Gulf humpback whale BIA overlaps the EMBA.

Noise loggers deployed near Woodside's GWA facility detected humpback whales present at the end of September, likely migrating south, and from June to mid-August in deeper water, nearer to the continental shelf, likely migrating north (RPS Environment and Planning 2012). The southward migration of cow/calf pairs is slightly later during October (and 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 when they are on the northern migratory path. During these migration periods, humpback whales are not likely to overlap the Operational Area.

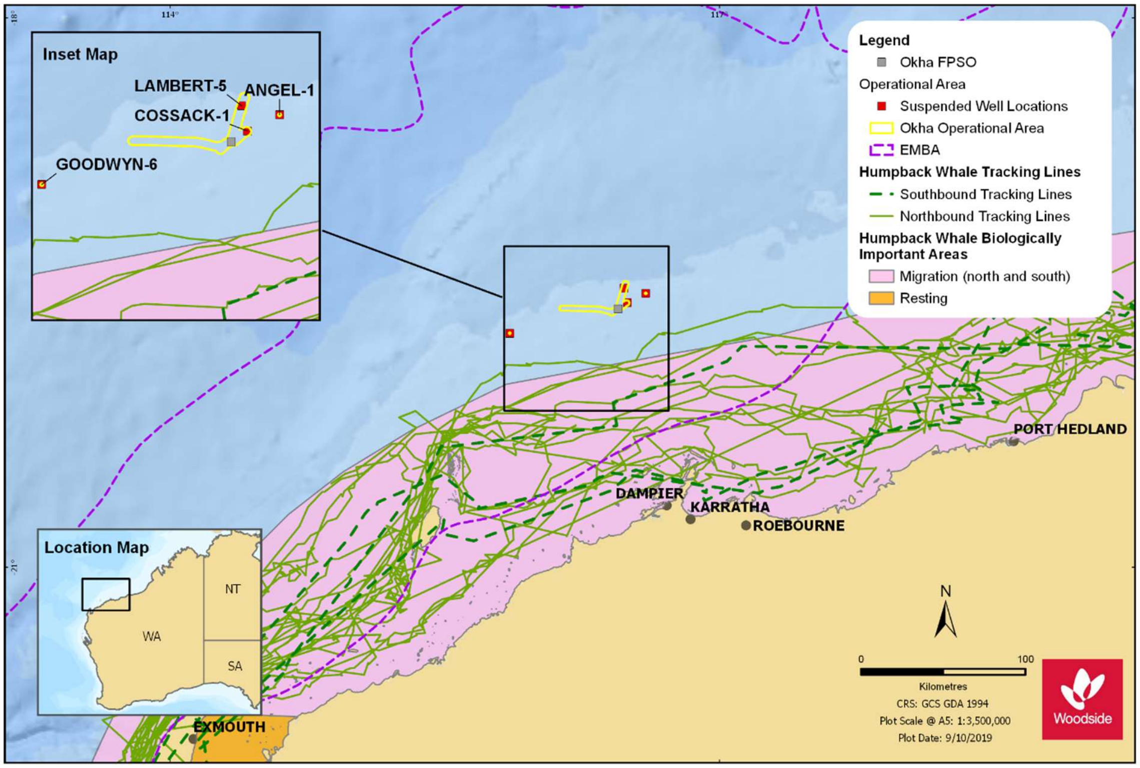

Figure 4-9: Humpback whale satellite tracks and BIA

Source: Double et al. 2010, 2012a

Sperm Whale

The sperm whale was identified as potentially occurring in the Operational Area and wider EMBA. Sperm whales are the largest of the toothed whales and are distributed worldwide in deep waters (>200 m) off continental shelves and sometimes near shelf edges (Bannister et al. 1996). The sperm whale is listed as a Migratory species under the EPBC Act. Sperm whales have been recorded in all Australian state waters and are known to migrate northward in winter and southwards in summer (Bannister et al. 1996). In WA, sperm whales have two BIAs recognised for foraging activities—west of Rottnest Island and along the southern coastline between Cape Leeuwin and Esperance. In deep water off the North West Cape, sperm whales have been sighted in pod sizes up to six animals between February and April from two separate surveys, in 2010 and 2017 (EPI Group 2017, RPS Environment and Planning 2010b).

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

Antarctic Minke Whale

Antarctic minke whales were identified as potentially occurring within the Operational Area and the wider EMBA. 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. The Antarctic minke whale is thought to migrate up the WA coast to ~20 °S to feed and possibly breed (Bannister et al. 1996); however, detailed information on the timing and location of migrations and breeding grounds is not well known. In the wider EMBA, the Antarctic minke whale may be seasonally present in low numbers during winter months. Their presence is likely to be a rare occurrence and limited to a few individuals infrequently transiting the Operational Area.

Southern Right Whale

Southern right whales were identified as potentially occurring within the wider EMBA. The southern right whale occurs primarily in waters between ~20 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 approximately 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 in the EMBA.

Cetaceans – Dolphins and Porpoises

Killer Whale

Killer whales were identified as potentially occurring within the Operational Area and wider EMBA. Killer whales are found in all of the world's oceans, from the Arctic and Antarctic regions to tropical seas and have been recorded off all states of Australia (Bannister et al. 1996, DoE 2013, Ford et al. 2005). Killer whales appear to be more common in cold, deep waters; however, they have been observed along the continental slope and shelf (Bannister et al. 1996), as well as in shallow coastal areas of WA (RPS Environment and Planning 2010a).

There are no recognised key localities or important habitats for killer whales within the Operational Area or wider EMBA. Given the wide distribution of killer whales and their preference for colder waters, the Operational Area is unlikely to represent an important habitat for this species; their presence is likely to be rare and limited to a few individuals infrequently transiting the area. The species is expected to be present in the wider EMBA.

Spotted Bottlenose Dolphin (Arafura/Timor Sea Populations)

There are four known subpopulations of the spotted bottlenose dolphins, of which the Arafura/Timor Sea population was identified as potentially occurring within the Operational Area and wider EMBA. The spotted bottlenose dolphin is generally considered to be a warm water subspecies of the common bottlenose dolphin. Distribution is primarily inshore waters, often in depths <10 m (Bannister et al. 1996). They are known to occur from Shark Bay, north to the western edge of the Gulf of Carpentaria. Given the distribution of spotted bottlenose dolphins, and their preference for shallow coastal waters, the Operational Area is unlikely to constitute important habitat for this species.

Their presence is likely to be rare and limited to infrequent transiting of the Operational Area, although they are expected to occur in the wider EMBA.

Indo-Pacific Humpback Dolphin

The Indo-Pacific humpback dolphin may be present in the wider EMBA, particularly at the Montebello Islands (Raudino et al. 2018), although this species was not identified as occurring within the Operational Area. The Indo-Pacific humpback dolphin is now recognised as two distinct species—the Indo-Pacific humpback dolphin (*Sousa chinensis*) and the Australian humpback dolphin (*S. sahulensis*) (Jefferson and Rosenbaum 2014). Distribution of the Indo-Pacific humpback dolphin in Australia is tropical, occurring north of 29 °S and 24 °S off the east and west coasts of Australia respectively (Bannister et al. 1996). Humpback dolphins inhabit shallow coastal, estuarine habitats in tropical and subtropical regions, generally in depths <20 m (Corkeron et al. 1997, Jefferson 2000, Jefferson and Rosenbaum 2014). Given their preference for shallow coastal habitats, the species is not likely to occur within the Operational Area but will occur within the wider EMBA.

Dugong

The dugong may be present in the wider EMBA, although was not identified as occurring within the Operational Area, which is offshore in deep water that does not support seagrass habitat and does not contain any critical dugong habitat. Dugongs are distributed along the WA coast throughout the Gascoyne, Pilbara and Kimberley, with notable populations in these areas (DSEWPaC 2012a, Marsh et al. 2002, Preen et al. 1997):

- Ningaloo Marine Park (State Waters) (~305 km south-west of the Operational Area)
- Exmouth Gulf (~272 km south-west of the Operational Area)
- Shark Bay (~610 km south of the Operational Area).

Dugong distribution is correlated with seagrass habitats in which dugong feed, although water temperature has also been correlated with dugong movements and distribution (Preen et al. 1997, Preen 2004). Dugongs are known to migrate hundreds of kilometres between seagrass habitats (Sheppard et al. 2006). Dugongs may occur along the Ningaloo Coast and around islands of the Pilbara Coast, within the wider EMBA.

The Operational Area does not encompass dugong BIAs; however, several do occur in the nearshore waters of Ningaloo Reef, within the wider EMBA (Table 4-5).

4.5.2.6 Marine Reptiles

Marine Turtles

Five of the six marine turtle species recorded for the NWMR have the potential to occur within the Operational Area (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 (80 m), and absence of potential nesting or foraging sites (i.e. no emergent islands, reef habitat or shallow shoals) the Operational Area is not considered an important habitat for marine turtles. Furthermore, while it is acknowledged that there are significant nesting sites along the mainland coast and islands of the region, the primary nesting beaches (such as within Dampier Archipelago and Montebello Islands) are >90 km from the Operational Area (note areas defined as nesting habitat critical to the survival of marine turtle species extend beyond nesting beaches, refer to Table 4-5 for a list of the minimum distances to these areas for each species).

Four of the turtle species (green, loggerhead, flatback and hawksbill) have significant nesting rookeries on beaches along the mainland coast and islands in the wider EMBA region including the Ningaloo Coast, and several significant nesting sites occur in the region beyond the wider EMBA, including the Muiron Islands and North West Cape (Commonwealth of Australia 2017, Limpus 2007, 2008a, 2008b, 2009). Table 4-7 has additional details of the marine turtle species identified, including breeding and nesting seasons, diet and key habitats within the NWMR (including areas outside the wider EMBA).

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

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
Green turtle	**Breeding**: Approximately September to December. **Nesting**: November to March. Peak period from January to March.	Seagrasses and algae	**Preferred habitat**: Nearshore reef habitats in the photic zone. **Distribution**: Ningaloo coast to Lacepede Islands. **Major nesting sites**: Montebello Islands, Barrow Island, Muiron Islands, some islands of the Dampier Archipelago, and North West Cape. **Internesting habitat**: Generally within 10 km of nesting beaches (Waayers et al. 2011).

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
			Nearest BIA/Critical Habitat: None overlap the Operational Area. Refer to Table 4-5 for BIAs/habitat critical to the survival of a species* within the wider EMBA.
Loggerhead turtle	**Breeding**: Approximately September to March. **Nesting**: November to March. Peak period from late December to early 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 (DSEWPaC 2012a). **Nearest BIA/Critical Habitat**: None overlap the Operational Area. Refer to Table 4-5 for BIAs/habitat critical to the survival of a species* within the wider EMBA.
Hawksbill turtle	**Breeding**: All year round. **Nesting**: All year round with peak in October to February.	Mainly sponges, also seagrasses, algae, soft corals and shellfish	**Preferred habitat**: Nearshore and offshore reef habitats. **Distribution**: Shark Bay north to Dampier Archipelago. **Major nesting sites**: The most significant rookery in WA is at Rosemary Island. Other rookeries include Varanus Island in the Lowendal group, some islands in the Montebello group and along the Ningaloo Coast (Limpus 2009). **Internesting habitat**: Limited data on Australian hawksbill turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (DSEWPaC 2012a). **Nearest BIA/Critical Habitat**: None overlap the Operational Area. Refer to Table 4-5 for BIAs/ habitat critical to the survival of a species* within the wider EMBA.
Flatback turtle	**Breeding**: September to January. **Nesting**: November to March with peak period in December to March.	Carnivorous, feeding mainly on soft bodied prey such as sea cucumbers, soft corals and jellyfish	**Preferred habitat**: Nearshore and offshore subtidal and soft-bottomed habitats of offshore islands. **Distribution**: Pilbara genetic stock: Shark Bay north to Dampier Archipelago. **Major nesting sites**: The largest nesting sites of the Pilbara region are 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

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
			east of Barrow Island, towards WA mainland coastal waters, between nesting events. **Nearest BIA/Critical Habitat**: An internesting BIA around the Montebello Islands overlaps the suspended exploration well (Goodwyn-6) section of the Operational Area. The boundary of the BIA is ~18 km from the Okha FPSO. Refer to Table 4-5 for BIAs/habitat critical to the survival of a species* within the wider EMBA.
Leatherback turtle	No confirmed nesting activity in WA.	Carnivorous, feeding mainly in the open ocean on jellyfish and other soft-bodied invertebrates	**Preferred habitat**: Nearshore, coastal tropical and temperate waters may be encountered within the NWMR but there are no known nesting sites within the NWMR. **Nearest BIA/Critical Habitat**: No known BIAs for leatherback turtles in the Operational Area or wider 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)*

Post-nesting migratory routes for green, hawksbill and flatback turtles have been recorded for the Pilbara area (Barrow Island and mainland sites) (Chevron Australia 2012). Green turtle tracking for post-nesting individuals from Scott Reef (Guinea 2011) indicates no overlap with the Operational Area. Green, flatback and hawksbill turtles travelling from nesting sites to foraging grounds generally move east or south of Barrow Island, around or through the Dampier Archipelago and along the coast towards foraging grounds to the north (north of Broome). The exception is hawksbill turtles, which travel south to the coastal island chain south of Barrow Island (Chevron Australia 2012). Tracking data indicate the turtles travel and forage in relatively shallow water, with hawksbill turtles in depths <10 m, green turtles <25 m and flatback turtles <70 m (Chevron Australia 2012).

Sea snakes

Sea snakes occur along the NWS Province 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). Most information on the occurrence of sea snakes has been sourced from bycatch logs maintained by the Northern Prawn Fishery (DEWHA 2008).

The short-nosed sea snake, listed as Critically Endangered under the EPBC Act, was identified as potentially occurring within the Operational Area. This species has primarily been recorded at Ashmore Reef and Cartier Island on the Sahul Shelf, which are >1000 km from the Operational Area and beyond the wider EMBA.

Sea snakes of the families Hydrophiidae and Laticaudidae are widespread in the wider EMBA and are protected under the EPBC Act. The PMST identified 16 species of sea snake listed as marine under the EPBC Act within the wider EMBA (Appendix C). The most commonly sighted sea snake in the region is the olive sea snake (*Aipysurus laevis*), which is generally found along lower reef edges and upper lagoon slopes of leeward reefs. The olive sea snake is associated with shallow water, as large, deepwater expanses create a significant barrier to movement. Given the water depth of the Operational Area, sea snake sightings will be infrequent and likely comprise few individuals.

4.5.2.7 Fishes and Elasmobranchs

Seahorses and Pipefish

The Protected Matters search identified 40 species of pipefish, pipehorses and seahorses listed as under the EPBC Act within the wider EMBA (Appendix C). Bycatch data (Department of Fisheries

2010) indicates they are uncommon in deeper continental shelf waters (50–200 m), so are unlikely to occur within the Operational Area. Species within this family (Syngnathidae) are commonly found in seagrass and sandy habitats around coastal islands and shallow reef areas along the NWS Province, and are likely to be found in coastal areas including the Ningaloo Coast. Within the wider EMBA, pipefish, pipehorses and seahorses may be encountered in a wide variety of shallow habitats, including seagrass meadows, reefs and sandy substrates.

Sawfish

Narrow Sawfish

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

Like other sawfish in the family Pristidae, the narrow sawfish prefers shallow coastal, estuarine and riverine habitats, although may occur in waters up to 100 m deep (D'Anastasi et al. 2013). Given the water depth of the Operational Area (~80–125 m) and distance from preferred habitats, narrow sawfish are not expected to occur within the Operational Area. However, the species may be found within the broader EMBA in shallow coastal waters and estuaries.

Green Sawfish

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

The Multi-species Recovery Plan for Sawfish and River Sharks indicates '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). The Operational Area is not considered a sensitive area for the green sawfish.

Given the water depth of the Operational Area (~80–125 m) and distance from preferred habitats, green sawfish are not expected to occur within the Operational Area. However, the species may be found within the broader EMBA, particularly mangroves and tidal creeks.

Dwarf Sawfish

The dwarf sawfish is found in Australian coastal waters extending north from Cairns around the Cape York Peninsula in Queensland to the Pilbara coast (Kyne et al. 2013) and was identified as potentially occurring within the wider EMBA. Dwarf sawfish typically inhabit shallow (2–3 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 (beyond the wider EMBA) and the lower reaches of the major rivers that enter the sound, including the Fitzroy, Mary and Robinson rivers (Morgan et al. 2010). Individuals have also been recorded from Eighty Mile Beach, and occasional individuals have also been taken from considerably deeper water from trawl fishing (Morgan et al. 2010). The species may be present in coastal waters within the wider EMBA.

Sharks

Whale Shark

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

After the aggregation period, the distribution of the whale shark is largely unknown. Tagging, aerial and vessel surveys suggest the group disperses widely, up to 1800 km away. Satellite tracking has shown that the sharks may follow three migration routes from Ningaloo Reef (Meekan and Radford 2010, Wilson et al. 2006) (Figure 4-10):

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

These tagging studies provided the justification for a foraging BIA for whale sharks that overlaps the Operational Area, as shown in Figure 4-10. 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. Whale sharks may traverse through the Operational Area during their migrations to and from Ningaloo Reef. However, whale shark presence within the area is expected to be of a relatively short duration and not in significant numbers, given the main aggregations are recorded in coastal waters, particularly the Ningaloo Reef edge (CALM 2005).

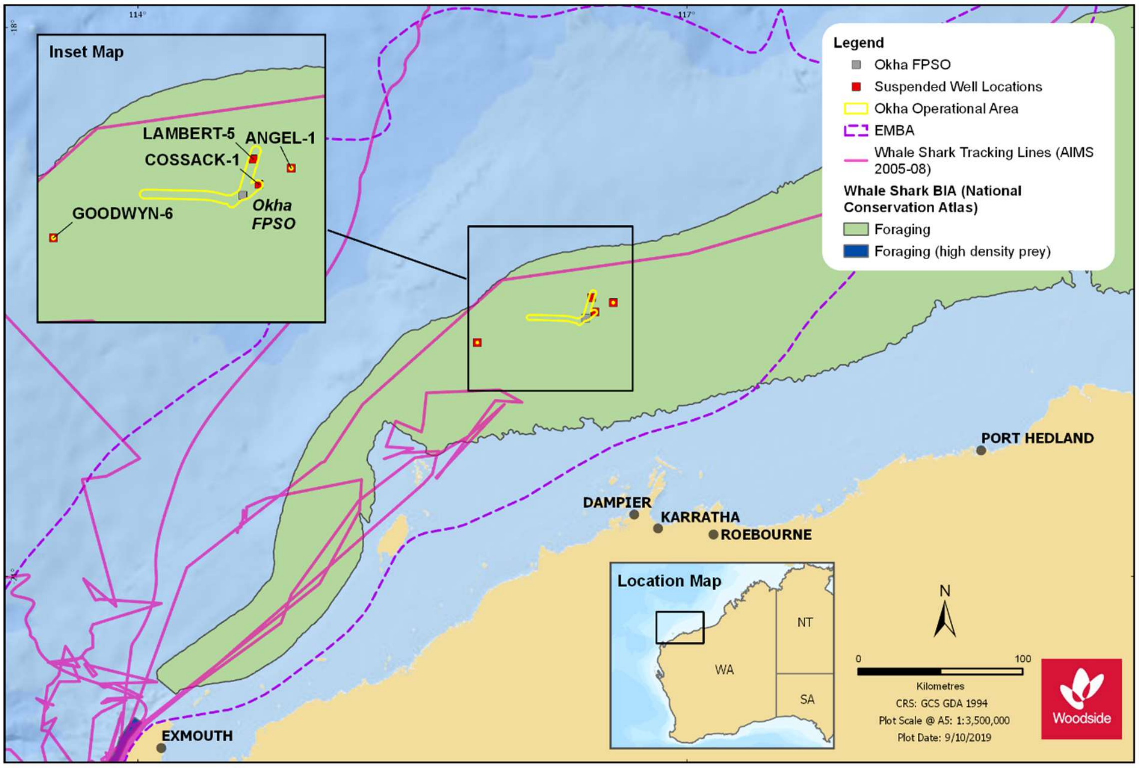

Figure 4-10: Satellite tracks of whale sharks tagged between 2005 and 2008

Source: Meekan and Radford (2010)

<u>Porbeagle Shark</u>

The porbeagle shark is found in temperate, sub-Arctic and sub-Antarctic waters worldwide, and was identified as potentially occurring within the wider EMBA. The species can thermo-regulate physiologically, allowing it to occupy cooler waters than other shark species. The porbeagle shark has a wide vertical range within the water column, with tagging studies recording the species between the surface and > 700 m water depth (Saunders et al. 2011). Given its preference for cooler waters (Bruce 2013), the porbeagle shark may occur in temperate waters in the wider EMBA.

<u>Grey Nurse Shark</u>

The grey nurse shark was identified as potentially occurring within the Operational Area. This 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 m and 140 m depth (Chidlow et al. 2006). Grey nurse sharks have been documented as aggregating in specific areas (typically reefs); however, no clear aggregation sites have been identified off WA (Chidlow et al. 2006). Given the species' preference for relatively shallow temperate waters, grey nurse sharks are unlikely to be present within the Operational Area but may occur within the wider EMBA.

<u>Great White Shark</u>

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

Given the migratory nature of the species, its low abundance, broad distribution in temperate waters across southern Australia and absence of preferred prey (pinnipeds), great white sharks are unlikely to occur within the Operational Area or EMBA.

Shortfin Mako

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

Longfin Mako

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

Scalloped Hammerhead

The scalloped hammerhead is not currently included in the EPBC Act PMST; 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 NSW (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 Area and wider EMBA.

Rays

Reef Manta Ray

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

Giant Manta Ray

The giant manta ray is broadly distributed in tropical waters of Australia and was identified as potentially occurring within the Operational Area. This 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 Area is not located in or adjacent to any known key aggregation areas for the species (e.g. feeding or breeding). However, the Ningaloo Coast, ~278 km south-west of the Operational Area but within the wider 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 Area is likely to be infrequent and restricted to individuals transiting the area.

Pelagic Fish

Southern Bluefin Tuna

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

4.5.2.8 Birds

Oceanic Seabirds and/or Migratory Shorebirds

The Operational Area 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 and contains no known critical habitats (including feeding) for any species. The NWMR lies within the East Asian-Australasian flyway for migratory birds; species migrating between East Asia and Australia may be present between late spring and early autumn (Table 4-6). Ten species of listed birds were identified by the EPBC Act PMST (Table 4-3) as potentially occurring within the Operational Area (Appendix C):

- common noddy
- common sandpiper
- eastern curlew
- great frigatebird
- lesser frigatebird
- osprey
- pectoral sandpiper
- red knot

- sharp-tailed sandpiper
- streaked shearwater.

A BIA for the migratory wedge-tailed shearwater overlaps the Operational Area, which is related to breeding between mid-August and April in the Pilbara. Note: The PMST report did not identify wedge-tailed shearwaters within the Operational Area, although it did identify the species may occur in the wider EMBA.

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 Province. These included various 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 2015c).

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

- Dampier Archipelago (93 km to Cohen Island)
- Montebello/Barrow/Lowendal Islands group (80, 114, and 103 km to State Nature Reserves/Conservation Parks, respectively)
- Pilbara Islands (North, Middle and South groups – 125, 156, and 233 km to closest State Nature Reserve, respectively)
- Muiron Islands (263 km to State Nature Reserve)
- Rowley Shoals (314 km to State Marine Park)
- Shark Bay (610 km).

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

Common Sandpiper

The common sandpiper is listed as migratory under the EPBC Act. The species is a small, migratory sandpiper 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). The species congregates in large flocks and forages in shallow waters and tidal flats between spring and autumn. Specific critical habitat in Australia has not been identified due to the species' broad distribution (Bamford et al. 2008). The common sandpiper may be present in coastal wetland and intertidal sand or mudflats throughout the wider EMBA, although is unlikely to occur in the Operational Area.

Common Noddy

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

Area (although the Operational Area does not constitute critical habitat for the species) and the wider EMBA, particularly around offshore and coastal islands.

Eastern Curlew

The eastern curlew is listed as critically endangered and migratory under the EPBC Act. The eastern curlew is Australia's largest shorebird and a long-haul flyer. The eastern curlew takes an annual migratory flight to Russia and north-eastern China to breed, arriving back home to Australia in August to feed on crabs and molluscs in intertidal mudflats (Bamford et al. 2008). No critical habitats for the eastern curlew have been identified in the Operational Area or wider EMBA.

Great Frigatebird

The greater frigatebird is listed as migratory under the EPBC Act. The species has a circumglobal distribution. The species breeds on offshore islands (generally March to November), and forages in waters surrounding breeding colonies, including Adele Island and Ashmore Reef (DSEWPaC 2012a), which lie beyond the wider EMBA.

Lesser Frigatebird

The lesser frigatebird was identified as potentially occurring within the Operational Area and is listed as migratory under the EPBC Act. It is usually seen in tropical or warmer waters around the coast of northern WA, the Northern Territory (NT), Queensland and northern NSW (DSEWPaC 2012a). Within the NWMR (beyond the wider EMBA) the lesser frigatebird is known to breed on Adele, Bedout and West Lacepede islands, Ashmore Reef and Cartier Islands (DSEWPaC 2012a). The lesser frigatebird feeds mostly on fish and sometimes cephalopods; all food is taken while the bird is in flight. Lesser frigatebirds generally forage close to breeding colonies. A foraging BIA (centred on Bedout Island) is within the wider EMBA, ~167 km east of the Operational Area.

Osprey

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

Pectoral Sandpiper

The pectoral sandpiper is listed as migratory under the EPBC Act. As with 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. The species occurs throughout mainland Australia between spring and autumn. The pectoral sandpiper prefers coastal and near-coastal environments such as wetlands, estuaries and mudflats. Given the species' preferred habitat, the pectoral sandpiper is not expected to occur within the Operational Area but is expected to occur in suitable habitats within the wider EMBA.

Red Knot

The red knot is listed as endangered and migratory under the EPBC Act. This species 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). As with other migratory shorebirds, the species occurs in coastal wetland and intertidal sand or mudflats throughout the wider EMBA but is unlikely to occur in the Operational Area due to the lack of suitable habitat.

Sharp-tailed Sandpiper

The sharp-tailed sandpiper is listed as migratory under the EPBC Act. Like other species of sandpiper, the sharp-tailed sandpiper is a migratory wading shorebird and seasonally migrates long distances between breeding grounds in the northern hemisphere and over-wintering areas in the southern hemisphere (Bamford et al. 2008). The species may occur in Australia between spring and autumn. The species is unlikely to occur within the Operational Area due to the lack of suitable habitat but may occur seasonally in coastal wetland and intertidal sand or mudflats throughout the wider EMBA.

Streaked Shearwater

The streaked shearwater is a migratory seabird with a broad distribution in the western Pacific Ocean. The species nests on offshore islands in temperate East Asia, including Japan and the Korean peninsula. During winter months the species migrates south, as far as northern Australia, where is occurs around islands and inshore waters. The species may occur in the Operational Area and wider EMBA during the austral winter.

4.6 Socioeconomic Environment

4.6.1 Cultural and National Heritage

4.6.1.1 European and/or Indigenous Sites of Significance

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

Within the wider EMBA, Ningaloo Reef, Exmouth, Barrow Island, the Montebello Islands and the Dampier Archipelago and adjacent foreshores have a long history of occupancy by Indigenous communities. Indigenous heritage places are protected under the *Aboriginal Heritage Act 1972* (WA) or EPBC Act. A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System was undertaken for the shoreline within the EMBA (Appendix G). The search indicated there are numerous registered sites, including middens, burial, ceremonial, artefacts, rock shelters, mythological and engraving sites recorded along the Ningaloo Coast (Appendix G). The exact location, access and traditional practices for a number of these sites are not disclosed and, if required (such as in a major hydrocarbon release), further consultation would be prioritised with key contacts within DPLH and local Indigenous communities (refer to Section 5).

4.6.1.2 Underwater Cultural Heritage

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

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

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

Vessel name	Year wrecked	Wreck location*	Latitude (WGS84)	Longitude (WGS84)	Distance from closest point of the Operational Area (km)
McDermott Derrick Barge No 20	1989	North-eastern tip of Eaglehawk Island, Dampier Archipelago	-20.14	115.95	47
McCormack	1989	North-eastern tip of Eaglehawk Island, Dampier	-20.14	115.95	47
Zelma	1990	Dampier Archipelago	-20.38	116.87	96

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

Source: DoEE (n.d.)

4.6.1.3 World, National, and Commonwealth Heritage Listed Places

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

- World Heritage Places:
  - Ningaloo Coast WHA (~259 km south-west of the Operational Area)
  - Shark Bay WHA (~610 km south-east of the Operational Area)
- National Heritage Places:
  - Dampier Archipelago (including Burrup Peninsula) Indigenous Heritage Place (~93 km south of the Operational Area)
  - Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves Nominated Heritage Place (~73 km south-west of the Operational Area)
  - Ningaloo Coast Natural Heritage Place (~277 km south-west of the Operational Area)
  - Shark Bay Natural Heritage Place (~610 km south of the Operational Area)
- Commonwealth Heritage Places:
  - Ningaloo Marine Area – Commonwealth Waters Natural Heritage Place (~279 km south-west of the Operational Area).

4.6.2 Ramsar Wetlands

No Ramsar wetlands overlap the Operational Area or wider EMBA.

4.6.3 Fisheries – Commercial

4.6.3.1 Commonwealth and State Fisheries

A number of Commonwealth and State fisheries are located within the Operational Area and wider EMBA. Table 4-9 provides further detail on the fisheries that have been identified through desk-based assessment and consultation (Section 5). Figure 4-11, Figure 4-12, and Figure 4-13 show the designated fisheries management areas in relation to the Operational Area.

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

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
Commonwealth Managed Fisheries				
Western Tuna and Billfish Fishery	✓	✓	✓	**Description:** The Western Tuna and Billfish Fishery is currently active, running throughout the year. The fishery zoning extends to the Australian EEZ boundary in the Indian Ocean, overlapping the Operational Area and wider EMBA. The fishery targets four pelagic species, which are all highly mobile: broadbill swordfish (*Xiphias gladius*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*), albacore tuna (*T. alalunga*). The number of vessels operating in the fishery has declined in recent years, with less than five vessels operating in the fishery since 2005 (Williams et al. 2017). Data shows fishing effort is concentrated off south-west WA and SA (Williams et al. 2017). The fishing methods used by the fishery are mainly pelagic longline and some minor-line. No significant effort in the vicinity of the Operational Area has been documented. Given the current effort level and recent distribution of effort, it is unlikely fishing by the Western Tuna and Billfish Fishery will occur within the Operational Area or wider EMBA. **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** Three vessels (two pelagic longline, one minor longline) (Williams et al. 2017).
Western Skipjack Tuna Fishery	✓	✓	✗	**Description:** The combined Western and Eastern Skipjack Tuna (*Katsuwonus pelamis*) fisheries encompass the entire Australian EEZ, including the Operational Area and wider 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 has declined and there have been no active vessels operating since 2009 (Patterson and Bath 2017). Given the fishery has been inactive for a number of years, and given the distribution of fishing effort when the fishery was active, fishing for skipjack tuna in the Operational Area is highly unlikely. If the fishery commences efforts in the area in the future, fishing effort in the Operational Area and wider EMBA is considered to be unlikely, given the historical fishery was concentrated off southern Australia. **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** Not applicable (fishery inactive) (Australian Fisheries Management Authority [AFMA], 2018). No vessels are active in the fishery.
Southern Bluefin Tuna Fishery	✓	✓	✗	**Description:** The Southern Bluefin Tuna Fishery boundary overlaps the Operational Area, but current effort within the fishery is largely confined to southern Australia, with most effort occurring in the Great Australian Bight (Patterson et al. 2017). Southern bluefin tuna 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.

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
				The fishery employs both longlining and purse seine net fishing methods. Given the current distribution of fishing effort and fishing methods used by the industry, fishing for bluefin tuna is unlikely to occur in the Operational Area or wider EMBA. **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** Six purse seine vessels, 16 longline vessels (Australian Bureau of Agricultural and Resource Economics and Sciences 2018).
North-West Slope Trawl Fishery	✗	✓	✗	**Description:** The North West Slope Trawl Fishery (NWSTF) extends from 114 °E to 125 °E, from the 200 m isobath to the outer limit of the Australian Fishing Zone (200 nm from the coastline), which is the boundary of the EEZ. The fishery traditionally targets scampi and deepwater prawns. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 200–400 m using demersal trawl gear on the continental slope. Activity in the fishery commenced in 1985, peaking at 21 active vessels in 1986–87 (Woodhams and Bath 2017a). There is currently high non-participation among licence holders, and fishing activity has steadily declined since establishing the fishery. Two vessels operated in the fishery in the 2015–16 season, an increase from one vessel in the 2014–15 season (Woodhams and Bath 2017a). The total area of waters fished in 2015–16 did not include the Operational Area, and efforts were focused in waters beyond the 200 m isobath to the north-east of the Operational Area (Woodhams and Bath 2017a). Given the fishery lies beyond the Operational Area, interaction with participants in the fishery is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** 24 km from Operational Area. **Licences/vessels:** Two vessels active in 2015–16 season (Woodhams and Bath 2017a).
Western Deepwater Trawl Fishery	✗	✓	✗	**Description:** The Western Deepwater Trawl Fishery is permitted to operate only in deep waters from the 200 m isobath, as far north as the North West Cape, beyond the Operational Area. This fishery targets a number of deepwater, demersal finfish and crustacean species. The nominated fishing grounds are extensive. However, most of the fishing effort is south and offshore of the North West Cape, with areas of medium- and high-density fishing activity south of Ningaloo Reef and west of Shark Bay, beyond the 200 m isobath (Woodhams and Bath 2017b). No vessels were active in the fishery in the 2014–15 or 2015–16 seasons (Woodhams and Bath 2017b). Given the fishery lies beyond the Operational Area, interaction with participants in the fishery is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** 195 km from Operational Area. **Licences/vessels:** None active in 2015–16 (Woodhams and Bath 2017b), nor 2017–2018 (DoF 2018).

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
State Managed Fisheries				
Pilbara Demersal Scalefish Fishery	✓	✓	✓	**Description:** The State-regulated Pilbara Demersal Scalefish Fishery is managed as part of the North Coast Demersal Scalefish Fisheries and includes the Pilbara Fish Trawl (Interim) Managed Fishery and the Pilbara Trap Managed Fishery. This fishery comprises several management units in the Pilbara and Kimberley regions, targeting a range of low- and high-value finfish species. Gear used in this fishery includes trawl, trap and line fishing, with trawl fishing accounting for the bulk of landings (Newman et al. 2017). The Pilbara Demersal Scalefish Fishery is managed through area closures, gear restrictions and the use individual effort allocations (Newman et al. 2017). The managed fishery boundary overlaps the Operational Area and wider EMBA. The Operational Area overlaps Area 1 and Area 6 of Zone 2, which is open to fishing, including trawl fishing. The Okha FPSO overlaps Area 6 of Zone 2, which has been closed to trawl fishing since 1998. The fishery has had fishing effort over the past 5 years and may be present during petroleum activities. The catch effort in 2018 for trawl was 1780 T, trap was 573 T, and line was 143 T (Department of Primary Industries and Regional Development [DPIRD] 2018). **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** 13 active in 2016 (three trawl, three trap and seven line fishery vessels) (Newman et al. 2017). At least three vessels operate within three separate 10 nm blocks that cover part of the Operational Area; these vessels have operated there for the past five years (DPIRD 2018).
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*), with other species from the genera Scomberomorus (Molony et al. 2015). This commercial fishery extends from Geraldton to the NT border. There are three managed fishing areas: Kimberley (Area 1), Pilbara (Area 2), and Gascoyne and West Coast (Area 3). Most of the catch is taken from waters off the Kimberley coast (Lewis and Jones 2017), reflecting the tropical distribution of mackerel species (Molony et al. 2015). Most fishing activity occurs around the coastal reefs of the Dampier Archipelago and Port Hedland area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development prior to spawning (Mackie et al. 2003). The catch effort in 2018 was 283 T (DPIRD 2018). Most of the fishing effort is beyond the Operational Area; however, in the past five years, fishing effort in the fishery has overlapped the Operational Area, and may be present during petroleum activities.

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
				Fishery boundary distance from Operational Area: Overlaps Operational Area. **Licences/vessels:** Not stated for 2017–2018 (AFMA 2018); not stated for 2015–16 or 2016–2017 (Lewis and Jones 2017); 14 vessels in 2014 (Molony et al. 2015); 51 licences in 2018 (DPIRD 2018)
Western Australian Abalone Managed Fishery	✓	✓	✗	**Description**: The Western Australian Abalone Fishery includes all coastal waters from the WA–SA border to the WA–NT border. The fishery is concentrated on the south coast (greenlip and brownlip abalone) and the west coast (Roe's abalone). Abalone are harvested by divers, limiting the fishery to shallow waters (typically <30 m). No commercial fishing for abalone north of Moore River (Zone 8 of the managed fishery) has taken place since 2011–2012 (Strain et al. 2017); interactions with participants in the fishery will not occur during the Petroleum Activities Program. The commercial fishery reported a total commercial catch of 49 T in 2016, and 49 T in 2018 (over 404 days) (DPIRD 2018). **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** 26 vessels active in Roe's abalone fishery (Strain et al. 2017); 22 vessels active in Roe's abalone fishery (Strain et al. 2018); 50 licences in 2018 (DPIRD 2018)
Onslow Prawn Managed Fishery	✓	✓	✗	**Description**: The Onslow Prawn Managed Fishery encompasses a portion of the continental shelf off the Pilbara; the managed fishery boundary entirely overlaps the Operational Area and wider EMBA. The fishery targets a range of penaeids (primarily king prawns), which typically inhabit soft sediments in <45 m water depth. Fishing is carried out using trawl gear over unconsolidated sediments (sand and mud). Total prawn catches in 2015 were ~10.1 T, considerably lower than other prawn fisheries (total north coast prawn landings in 2015 were 175 T) (Sporer et al. 2017). Given the water depth of the Operational Area is significantly deeper than the preferred habitat of target species, interaction with participants in the Onslow Prawn Managed Fishery while undertaking the Petroleum Activities Program is very unlikely. Annual landing in 2015 of ~10.1 T. The catch was negligible in the 2015/16 season, at <1 T (Gaughan and Santoro 2018). The catch effort in 2018 was negligible (DPIRD 2018). **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** Not specified in Sporer et al. (2017); one vessel (Kangas et al. 2018); 30 licences in 2018 (DPIRD 2018)
Pearl Oyster Managed Fishery	✓	✓	✗	**Description:** The Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. Pearl oysters (*Pinctada maxima*) are collected by divers in shallow coastal waters along the NWS and Kimberley, which are mainly used to culture pearls (Hart et al. 2017). The fishery is separated into four zones. The Operational Area overlaps Zone 1, which extends from North West Cape to Cape Thouin. Fishing recently recommenced in Zone 1 after a hiatus of several years (Hart et al. 2017). The portion of the total catch in Zone 1 was minor in 2016–17 (3%) (Hart et al. 2017). Fishing in Zone 1 has occurred as a low

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
				proportion (<1%) of the total annual catch after a hiatus from 2008–2013 (Hart et al. 2018). The catch effort in 2018 was 468,573 oysters (12,845 dive hours) (DPIRD 2018). Given the fishery is diver-based (i.e. restricted to safe diving depths), interaction with fishery participants during the Petroleum Activities Program is very unlikely. **Fishery boundary distance from Permit Area:** Overlaps Operational Area. **Licences/vessels:** 20,445 diver hours (Hart et al. 2017); 6 vessels in 2016; 19,699 diver hours (Hart et al. 2018).
West Coast Deep Sea Crustacean Managed Fishery	✓	✓	✗	**Description**: The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the WA–NT border in water depths >150 m within the Australian Fishing Zone (i.e. EEZ), including the Operational Area. The fishery targets deepwater crustaceans, with most (>99%) of the catch landed in 2015 comprising crystal crabs (How and Yerman 2017). Two vessels operated in the fishery in 2015, using baited pots in a longline formation in the shelf edge waters, mostly in depths between 500 and 800 m (How and Yerman 2017). Fishing effort was concentrated between Fremantle and Carnarvon. Given fishing effort is concentrated beyond the Operational Area, interaction between participants in the fishery during the Petroleum Activities Program are unlikely. The catch effort in 2018 was 153.7 T (DPIRD 2018). **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** Two active vessels in 2015 (How and Yerman, 2017); two active vessels in 2016 (How and Yerman, 2018); seven licences in 2018 (DPIRD 2018)
South West Coast Salmon Managed Fishery	✓	✓	✗	**Description**: The South West Coast Salmon Managed Fishery operates on various beaches south of the Perth metropolitan area and includes all WA waters north to 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 Cape Beaufort (WA–NT border). Landings in the fishery during 2015 (most recently available statistics) were ~119 T (Smith and Baudains 2017). No interactions with participants in the fishery will occur during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** Overlaps Operational Area. **Licences/vessels:** Not applicable (shore-based); six licences in 2018 (DPIRD 2018)
Marine Aquarium Managed Fishery	✓	✓	✗	**Description:** The Marine Aquarium Fishery can be conducted in State Waters, within the Operational Area and wider EMBA. This fishery is primarily a dive-based fishery that uses hand-held nets to capture target species; it operates from boats up to 8 m long. Therefore, this fishery is unlikely to operate within the Operational Area. The fishery is typically active from Esperance to Broome, with popular areas including the

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
				coastal waters of the Capes region, Dampier and Exmouth. In 2017, eight licenses operated in this fishery. The landed catch was predominantly ornamental fish but also included hermit crabs, seahorses, invertebrates, and corals (Newman et al. 2014). Recent data indicates the fishery has not been active in the Montebello/Barrow Island area since 2013, when less than three vessels were active (DPIRD 2019b). **Fishing boundary distance from the Operational Area:** Overlaps Operational Area. **Licences:** Eleven licences were active in 2016 (Newman et al. 2018).
Specimen Shell Managed Fishery	✓	✓	✗	**Description:** The Specimen Shell Fishery can be conducted in WA State Waters, adjacent to the Operational Area and within the EMBA. This fishery targets specimen shells for display, collection, cataloguing and sale. Collection is predominantly by hand when diving or wading in shallow, coastal waters, though a deeper-water collection aspect to the fishery has been initiated with the use of ROVs operating at depths up to 300 m (Hart and Crowe 2015). The fishery encompasses the entire WA coastline, but effort is concentrated in area adjacent to populated areas such as Broome, Karratha, Shark Bay, Mandurah, Exmouth, Capes area, Albany and Perth (Hart and Crowe 2015), and is therefore unlikely to operate within the Operational Area. This fishery reported a total catch of 8531 shells in 2016, with a catch rate of 10–40 shells per day. **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** In 2017 there were 31 licence holders in the fishery, with 23 of these being active in 2016 (Hart et al. 2018c).
Exmouth Gulf Prawn Managed Fishery	✗	✓	✗	**Description**: The Exmouth Gulf Managed Fishery targets penaeid prawns (primarily banana prawns) using trawl gear within Exmouth Gulf. The target species typically inhabits sandy and muddy substrate in <45 m water depth. The fishery is of high value, with ~1067 T landed in 2015. Exmouth is the main port for participants in the fishery. In the 2016 season, a fishing effort of about 23,000 hours resulted in a catch of 822 T. The fishery is managed based on input controls, temporal closures and spatial closures (Kangas et al. 2017c). The catch effort in 2018 was 713 T (DPIRD 2018). Given the fishery lies beyond the Operational Area, interaction with participants in the fishery is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** ~243 km from Operational Area. **Licences/vessels:** Not specified in Kangas et al. (2017c); six vessels in 2015 (Sporer et al. 2015a); 15 licences in 2018 (DPIRD 2018)
Nickol Bay Prawn	✗	✓	✗	**Description:** The Nickol Bay Prawn Managed Fishery targets penaeid prawns (primarily banana prawns) using trawl gear. The target species typically inhabits sandy and muddy substrate in <45 m water depth. Landings in the fishery in 2015 were ~87 T, comprised largely of banana prawns (Sporer et al. 2017). Annual

Fishery	Operational Area	Within wider EMBA	Potential for interaction within Operational Area	Description
Managed Fishery				landing in 2015 of ~87 T. Low effort produced a catch of 17 T in 2016 (Kangas et al. 2018). The catch effort in 2018 was 227 T (DPIRD 2018). Given the fishery lies beyond the Operational Area, interaction with participants in the fishery is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** ~15 km from Operational Area. **Licences/vessels:** Not specified in Sporer et al. (2017); 14 licences in 2018 (DPIRD 2018).
Northern Demersal Scalefish Managed Fishery	✗	✓	✗	**Description**: The Northern Demersal Scalefish Managed Fishery operates off the north-west coast of WA in waters east of 120° E longitude, outside the Operational Area, but within the wider EMBA. The permitted means of operation within the fishery include handline, dropline and fish traps, but since 2002 it has essentially been a trap-based fishery, which uses gear time access and spatial zones as the primary management measures. The main species landed by this fishery are red emperor and goldband snapper (Newman et al. 2017). The catch effort in 2018 was 1317 T (DPIRD 2018). Given the fishery lies beyond the Operational Area, interaction with participants in the fishery is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** ~357 km from Operational Area. **Licences/vessels:** Seven vessels in 2015 (Newman et al. 2017); 15 licences in 2018 (DPIRD 2018).
West Coast Rock Lobster Managed 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). 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. Landings in 2015 were 6416 T (de Lestang and Rossbach 2017). In 2016, 226 vessels reported a total catch of 6086 T (Gaughan and Santoro, 2018). The catch effort in 2018 was 6400 T (DPIRD 2018). Given the fishery lies beyond the Operational Area, interaction with participants in the fishery is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Area:** ~247 km from Operational Area. **Licences/vessels:** 230 vessels in 2015 (de Lestang and Rossbach 2017); 226 vessels in 2016 (Gaughan and Santoro,2018); 643 licences in 2018 (DPIRD 2018).

NOTE: The Pilbara Crab Managed Fishery overlaps the Operational Area, but as it was started in late 2018, there is no further information available.

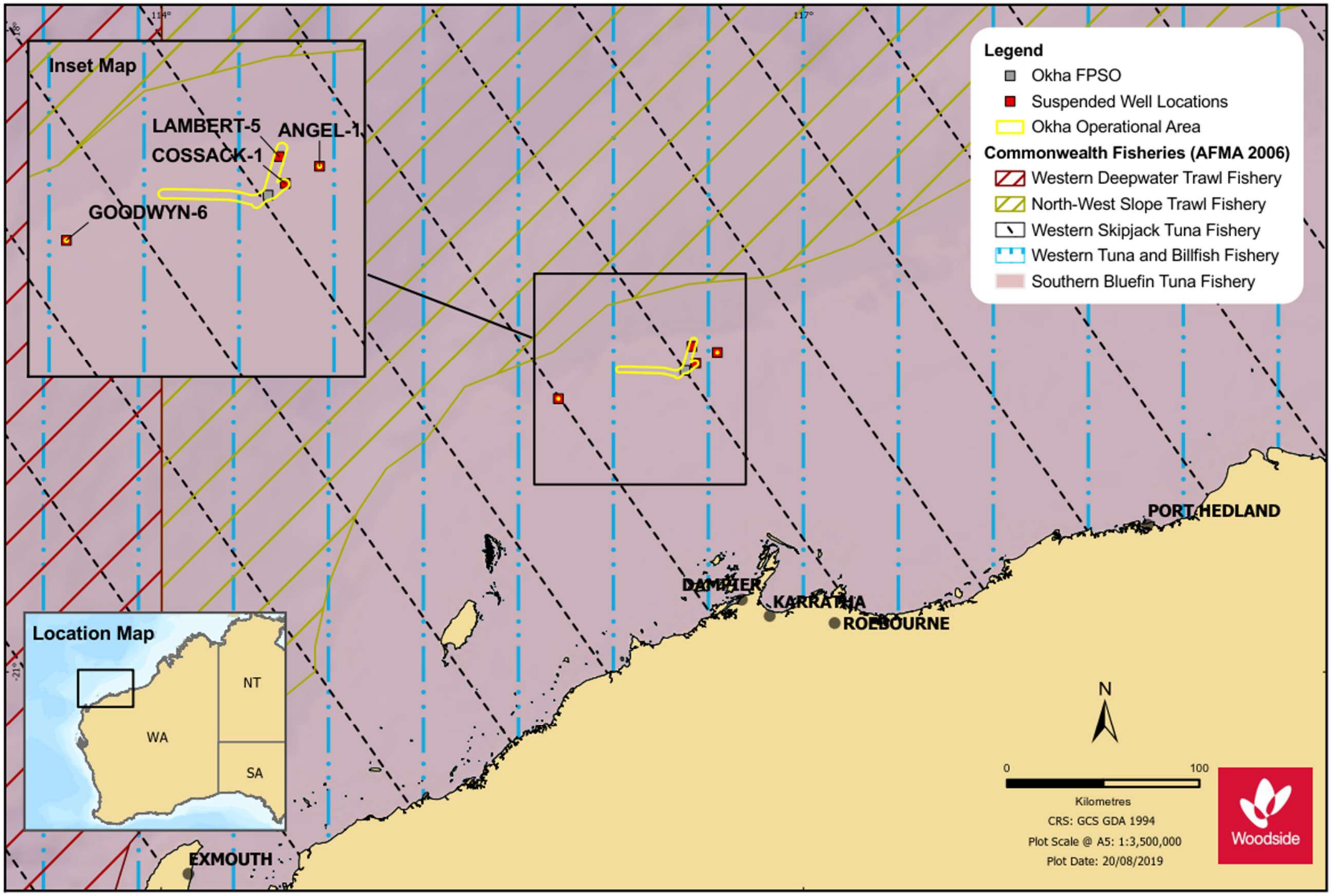

Figure 4-11: Location of Commonwealth fisheries in relation to the Operational Area

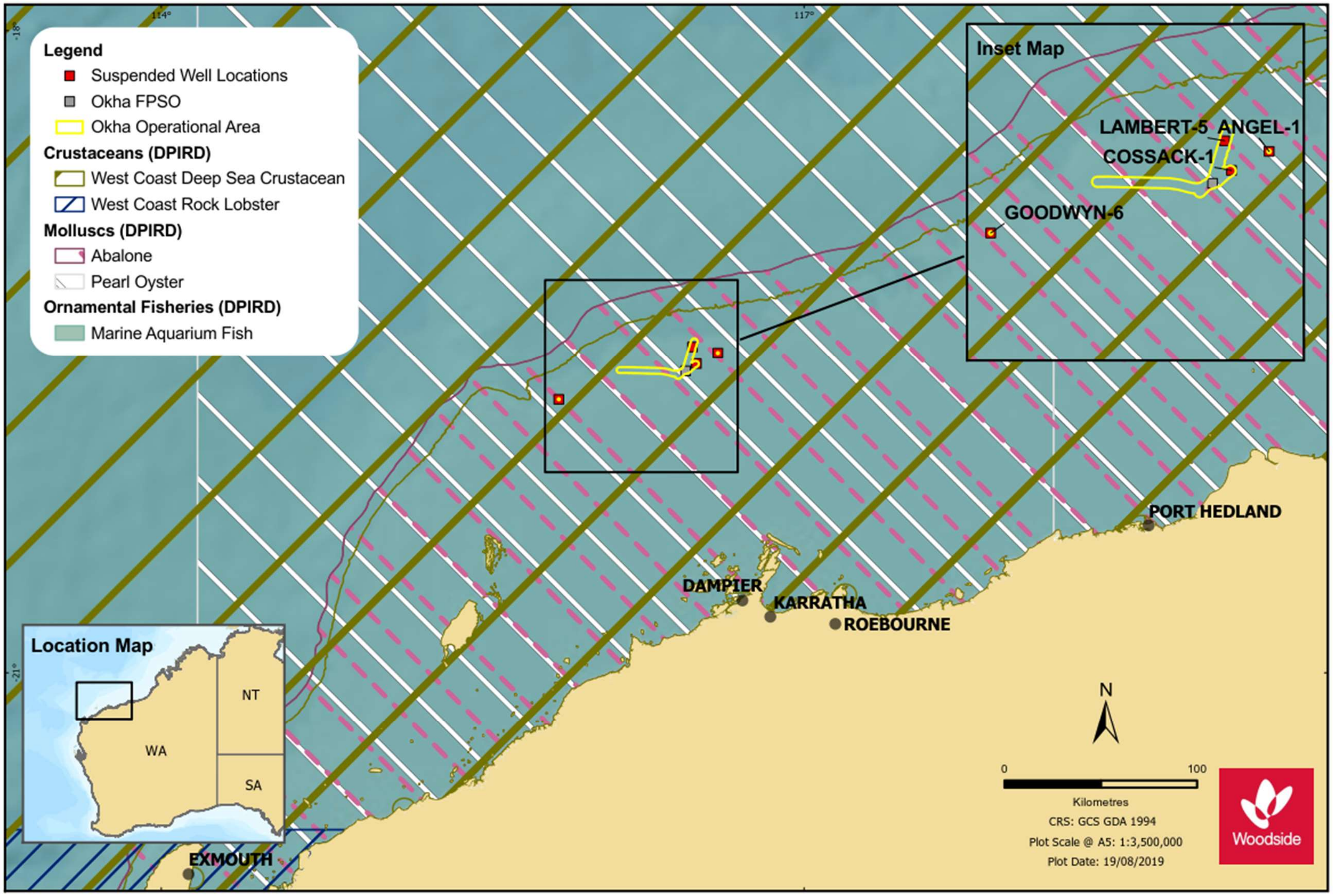

Figure 4-12: Location of State fisheries in relation to the Operational Area

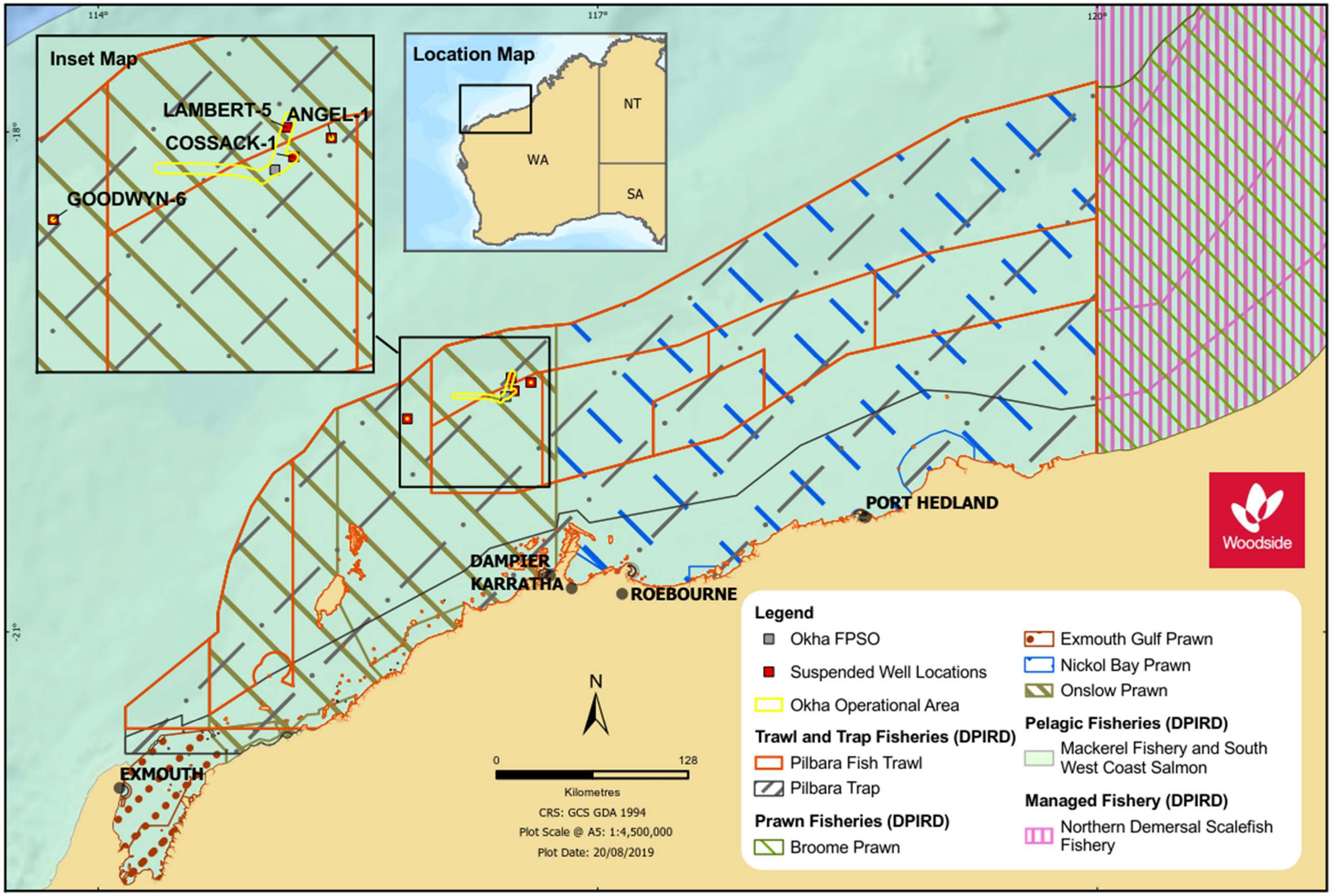

Figure 4-13: Location of State fisheries in relation to the Operational Area

4.6.3.2 Aquaculture

No aquaculture operations occur within the Operational Area—these operations are typically restricted to shallow coastal waters. Aquaculture in the region consists primarily of culturing hatchery-reared and wild-caught oysters (*Pinctada maxima*) for pearl production, which is primarily centred around Broome and the Dampier Peninsula. Leases typically occur in shallow coastal waters <20 m deep (Fletcher et al. 2006). There are existing pearl aquaculture leases at the Montebello Islands (within the wider EMBA), although they are not currently active (Fletcher et al. 2017).

Pearl oyster spawning primarily occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Fletcher et al. 2006).

4.6.4 Fisheries – Traditional

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

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

4.6.5 Tourism and Recreation

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

Tourism is one of the major industries of the Gascoyne region and contributes significantly to the local economy in terms of both income and employment. The main marine nature-based tourist activities are concentrated around and within the Ningaloo WHA (~259 km south-west of the Operational Area) and North West Cape area, including recreational fishing, snorkelling and scuba diving, whale shark (April to August) and manta ray (year round) encounters, whale watching (July to October), whale encounters (August and November) and turtle watching (all year round) (Schianetz et al. 2009). Recreational fishing and diving charters also visit some offshore islands within the EMBA and socio-cultural EMBA (e.g. Montebello Islands, Thevenard Island [where there is permanent accommodation], Muiron Islands, Rowley Shoals, and islands within the Dampier Archipelago).

4.6.5.1 Ningaloo Coast

Marine nature-based tourism attracts >270,000 annual visitors to the region, with an estimated $127 million AUD spent annually by visitors to the Ningaloo Marine Park and Cape Range National Park (CALM 2005, Jones et al. 2009).

The main marine nature-based tourist activities are snorkelling and scuba diving, whale shark encounters and whale-watching. Most diving takes place relatively close to shore (e.g. Ningaloo and

Bundegi Reefs) and around the reefs fringing the offshore islands (e.g. Muiron and Serrurier Islands). Whale-watching and whale shark encounters take place during the seasonal migration/aggregation periods, and these activities generally occur within the Ningaloo Marine Park. Coral Bay is one of the most heavily used areas (DEC 2007).

The warm, dry winter climate of the North West Cape area along with accessible fish stocks have made it a focal point for winter recreation by the WA community, and it is frequented by recreational fishers (Smallwood et al. 2011). Recreational fishers predominantly target tropical species, such as emperor, snapper, grouper, mackerel, trevally and other game fish, with recreational fishing activity peaking between April and October (Smallwood et al. 2011). The highest recreational fishing intensity, based on private boats, is generally centred around the public boat ramps. During 1998–99, between 1500 to 2500 recreational fishing boats were recorded within the vicinity of Bundegi boat ramp, which was the highest recorded along the Ningaloo Coast (DEC 2007).

The charter boat industry in the region has various operators in Exmouth and Coral Bay offering tourists half- and full-day fishing charters; however, there has been no recorded fishing effort from charter vessels in the operational area in the last five years.

4.6.5.2 Shark Bay

Tourism in the Shark Bay area has largely been based on the dolphins at Monkey Mia; however, nature-based tourism has been expanding due to the area’s unique ecosystem, land and seascapes, abundant wildlife and cultural values. The region is also a popular destination for recreational fishers. Tourism is a growing industry in the Gascoyne region and makes a major contribution to the local economy. From 2005 to 2007, tourism contributed an estimated $159 million AUD annually to the region’s economy (SGS Economics & Planning 2012).

4.6.6 Shipping

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

The Australian Maritime Safety Authority (AMSA) has introduced a network of marine fairways across the NWMR 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. Note: None of these fairways intersect with the Operational Area (Figure 4-14). Vessel tracking data suggests shipping is concentrated east of the Operational Area, and is likely associated with Woodside oil and gas facilities.

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

- Port of Dampier (~119 km south of the Operational Area)
- Port of Barrow Island (~138 km south of the Operational Area)
- Port of Port Hedland (~234 km south-east of the Operational Area)
- Port of Ashburton, at Onslow (~256 km south-west of the Operational Area).

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

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

- commercial and recreational fishing vessels.

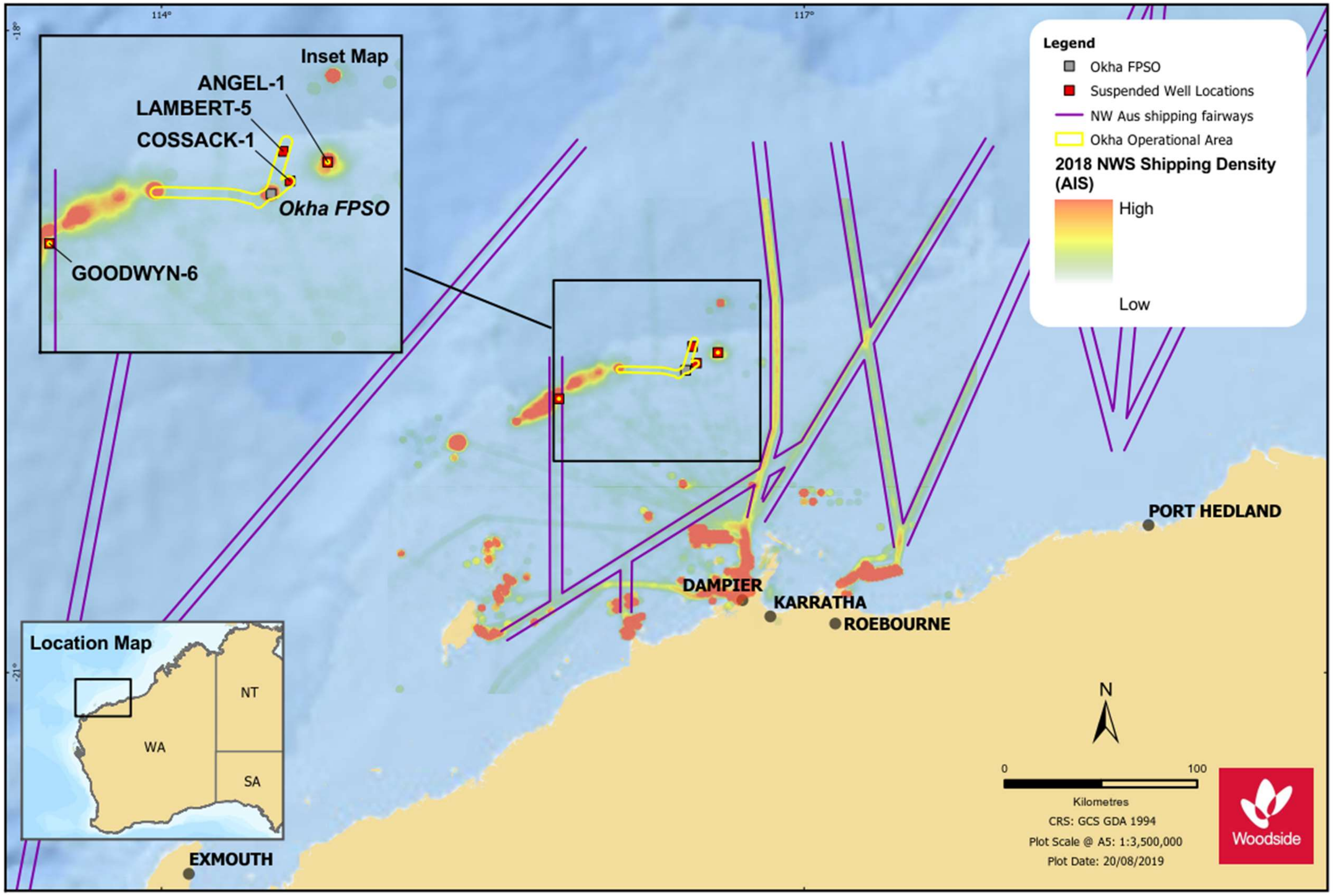

Figure 4-14: Vessel density map in the vicinity of Operational Area from 2016, derived from AMSA satellite tracking system data (vessels include cargo, LNG tanker, passenger, support and other vessels)

4.6.7 Oil and Gas Infrastructure

The Operational Area is located within an area of established oil and gas operations in the broader NWMR. Table 4-10 lists other facilities (FPSOs and platforms) currently in operation in the vicinity of the Operational Area (as shown in Figure 4-15).

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

Facility name (Operator)	Approximate distance from Operational Area (km)	Approximate distance from Okha FPSO (km)	Direction
NRC (Woodside)	Overlapping	32	West
Angel (Woodside)	Overlapping	20	East
GWA (Woodside)	11	54	South-west
Reindeer (Santos)	45	51	South
Stag (Santos)	76	81	South
Wheatstone (Chevron Australia)	55	118	South-west
Pluto (Woodside)	60	122	South-west

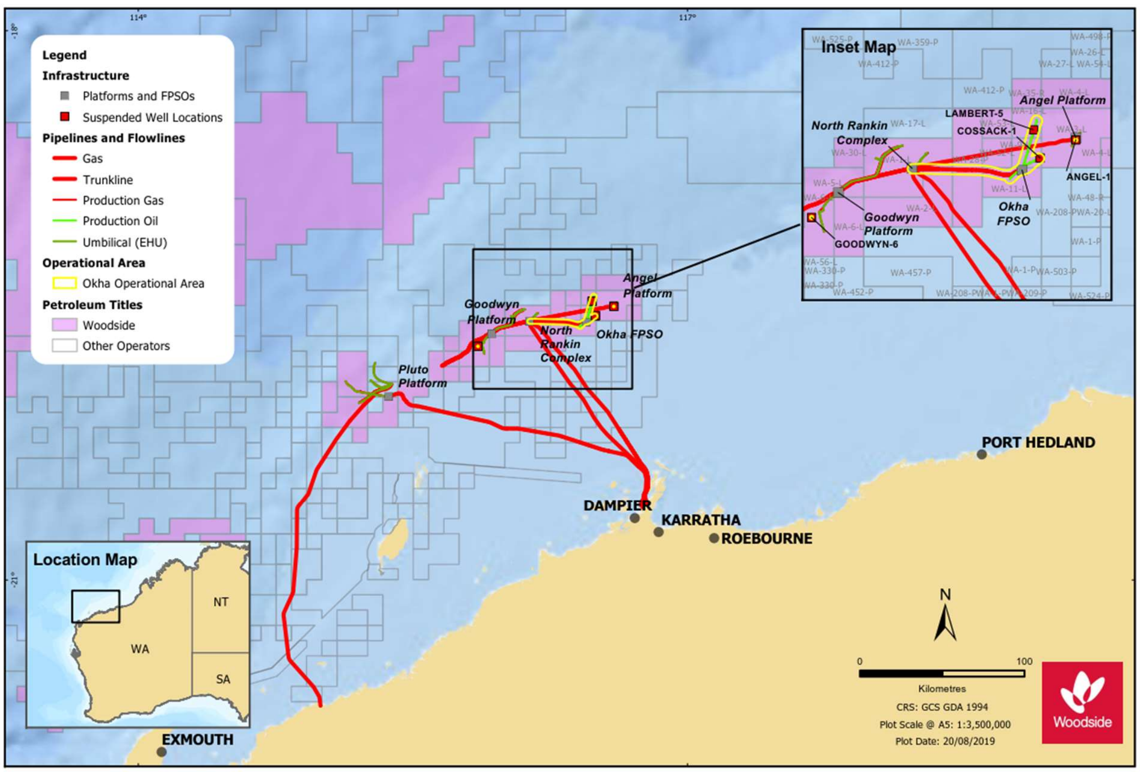

Figure 4-15: Oil and gas infrastructure with reference to the location of the Operational Area

4.6.8 Defence

There are designated defence practice areas in the offshore marine waters off Ningaloo and North West Cape, beyond the Operational Area (Figure 4-16). A Royal Australian Air Force base at Learmonth, on North West Cape, is ~350 km of the Operational Area.

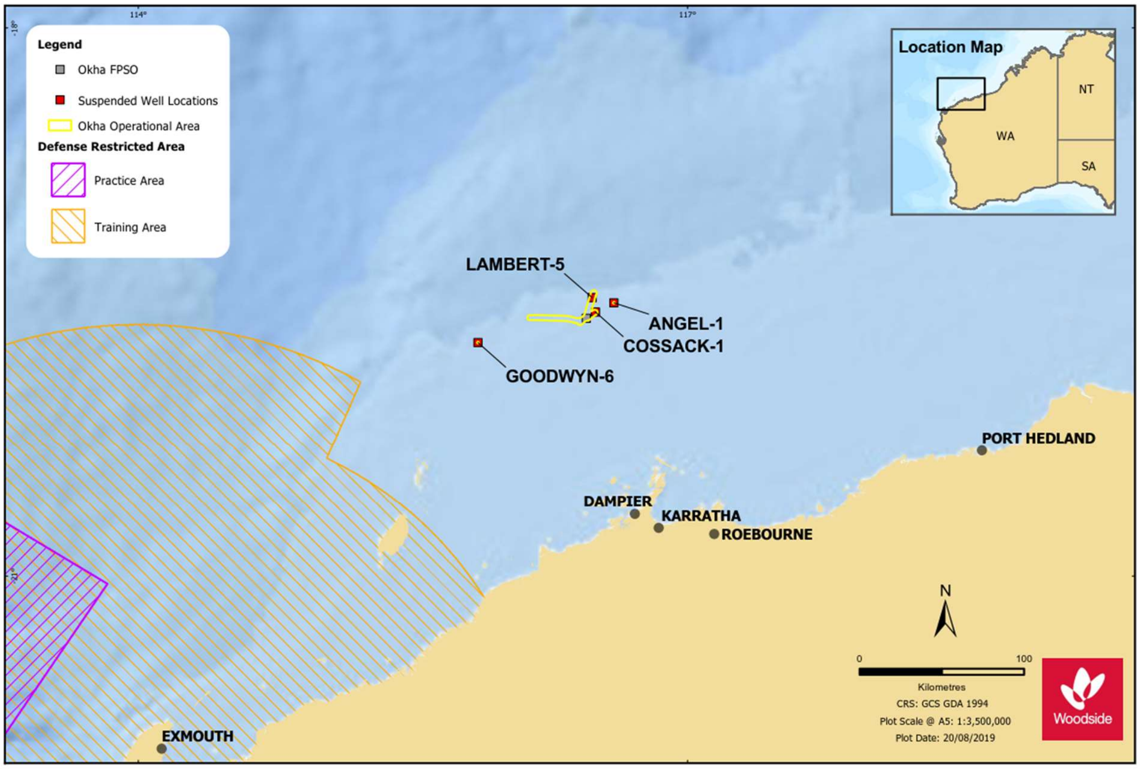

Figure 4-16: Department of Defence demarcated marine offshore areas for military and defence practice with reference to the location of the Operational Area

4.7 Values and Sensitivities

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

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

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

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

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

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

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

The following subsections outline the values and sensitivities of the established and proposed Marine Protected Areas (MPAs) and other sensitive areas in the EMBA and socio-cultural EMBA (listed in Table 4-11, shown in Figure 4-7). In addition, these areas are also considered in the environmental risk evaluation of planned and unplanned activities associated with the Petroleum Activities Program.

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

	Distance from Operational Area to Values/Sensitivity boundaries (km)	IUCN Protected Area Category[1]
Australian Marine Parks (AMP) (formerly Commonwealth Marine Reserves)		
Montebello[2]	35	VI
Argo-Rowley Terrace[2]	187	II, VI
Gascoyne[2]	250	II, IV, VI
Ningaloo[2]	279	IA
Shark Bay	610	IV
State Marine Parks and Nature Reserves		
Marine Parks		
Montebello Islands	73	IA, II, IV, VI
Barrow Island	124	IA, IV, VI
Ningaloo	279	IA, II, IV
Rowley Shoals	317	II
Shark Bay	610	IA, II
Marine Management Areas		
Barrow Island	94	IA, IV, VI
Muiron Islands	259	IA, VI
Fish Habitat Protection Areas		
None identified within the Operational Area. EMBA or socio-cultural EMBA		
Nature Reserves		
Lowendal Islands Nature Reserve	103	IA

	Distance from Operational Area to Values/Sensitivity boundaries (km)	IUCN Protected Area Category[1]
Barrow Island Nature Reserve	114	IA
Heritage		
World Heritage Areas		
The Ningaloo Coast	259	N/A
Shark Bay	610	N/A
National Heritage Areas		
Dampier Archipelago (including Burrup Peninsula)	93	N/A
The Ningaloo Coast	305	N/A
Shark Bay	610	N/A
Commonwealth Heritage Areas		
Ningaloo Marine Area – Commonwealth Waters	277	N/A
Key Ecological Features		
Ancient Coastline at 125 m Depth Contour	Overlapping	N/A
Glomar Shoal	3	N/A
Continental Slope Demersal Fish Communities	40	N/A
Exmouth Plateau	155	N/A
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	231	N/A
Commonwealth Waters adjacent to Ningaloo Reef	278	N/A
Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals	308	N/A

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

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

[2] *AMPs are part of the North-west Marine Parks Network.*

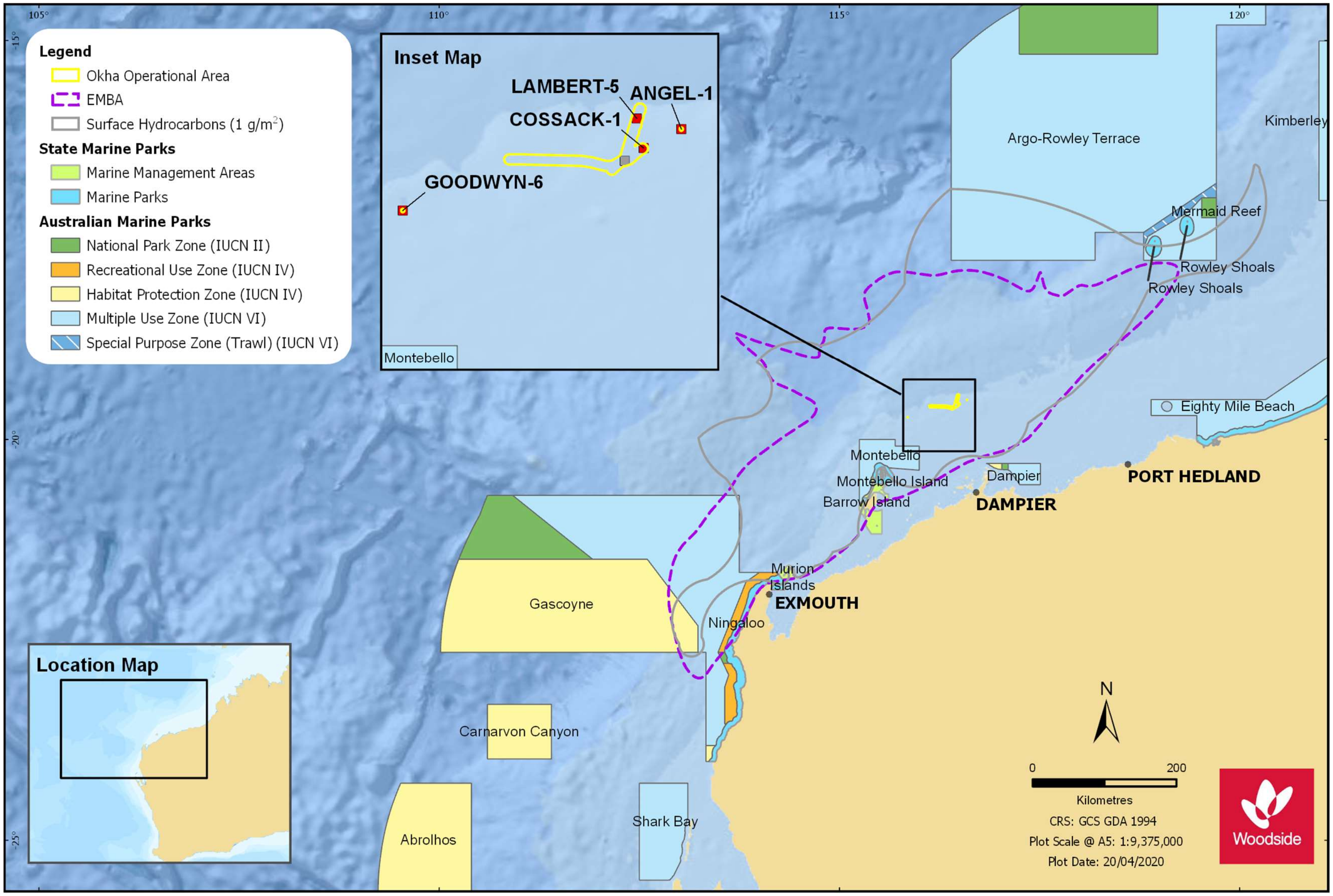

Figure 4-17: Commonwealth and State Marine Protected Areas in relation to the Operational Area

4.7.1 Montebello/Barrow/Lowendal Islands

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

4.7.1.1 Montebello AMP

The Montebello AMP is adjacent to the Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area, providing a contiguous marine park covering both State and Commonwealth Waters. Major conservation values within the Montebello AMP include (DoEE n.d., DNP 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 4.5.2)
- two historic shipwrecks, the *Trial* and the *Tanami* (both >100 km from the Operational Area)
- diverse social values including tourism, fishing, mining and recreation
- foraging areas adjacent to important nesting sites for marine turtles
- part of the migratory pathway of the protected humpback whale
- shallow shelf environments with depths ranging from 15 m to 150 m, providing protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features
- examples of the seafloor habitats and communities of the NWS Province bioregion as well as the Pilbara (offshore) mesoscale bioregion (Heap et al. 2005)
- one KEF for the region, the Ancient Coastline at 125 m Depth Contour (Section 4.7.5).

The entire Montebello AMP, an area of 341,300 ha, is designated a multiple use zone (IUCN Category IV), allowing for long-term protection and maintenance of the AMP in conjunction with sustainable use, including oil and gas exploration activities. The Montebello AMP is 35 km from the Operational Area.

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

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

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

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

The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are jointly managed, cover a combined area of 1770 km^2, and are ~73 km from the Operational Area at the closest point. A sanctuary zone covers the entire 4100 ha Barrow Island Marine Park. The Barrow Island Marine Management Area covers 114,500 ha and includes most of the waters surrounding Barrow Island and Lowendal Islands, except for the port areas around Barrow and Varanus Islands. Key conservation and environmental values within the reserves include (DEC 2007):

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

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

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

4.7.1.3 Barrow Island Nature Reserve

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

The Barrow Island coastline comprises dry creek beds, beaches, clay and salt flats, mangroves, intertidal flats and reefs and is bordered by high cliffs on the western side. Key conservation values 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 Indigenous and other European use including 13 registered Indigenous cultural heritage sites.

4.7.1.4 Lowendal Islands Nature Reserve

The Lowendal Islands Nature Reserve incorporates the islands of the Lowendal Archipelago, ~39 km south of Montebello Islands.

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

Key conservation values within the reserve include:

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

4.7.2 Ningaloo Coast Gascoyne

4.7.2.1 Ningaloo Coast World Heritage Area

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

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

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

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

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

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

4.7.2.2 Ningaloo AMP

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

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

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

The Ningaloo AMP (Commonwealth Waters) Management Plan outlines objectives for retaining the values of this protected area and any potential or confirmed threats that could impact these values. Values that could be impacted from the Petroleum Activities Program and the associated management objectives (goals and strategies) in the Management Plan are outlined in Table 4-12. 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 4-12: 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 6.8

Value potentially impacted by Petroleum Activities Program	Relevant existing and potential threats identified in Management Plan	Associated management objectives (strategies/goals)	Relevant EP section
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 6.8
Marine mammals and fish (e.g. whales; dugong; whale sharks)	Oil/chemical spill		
Marine reptiles (e.g. turtles)	Oil/chemical spill		
Seabirds	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 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 6.8

4.7.2.3 Ningaloo Marine Park and Muiron Islands Marine Management Plan

The Ningaloo Marine Park (State Waters) was established in 1987 and stretches 300 km from the North West Cape to Red Bluff. 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
- mangroves occurring only in the northern part of the Ningaloo Marine Park, important for reef fish communities (Cassata and Collins 2008) and supporting a high diversity of infauna, particularly molluscs (600 mollusc species)
- diverse fish fauna (~460 species)
- foreshores and nearshore reefs of the Ningaloo coast and Muiron/Sunday islands providing internesting, nesting and hatchling habitat for several species of marine turtles including the loggerhead, green, flatback and hawksbill turtles
- whale sharks aggregating annually to feed in the waters around Ningaloo Reef, from March to July, with the largest numbers being recorded around April and May (Sleeman et al. 2010). The season can be variable, with individual whale sharks being recorded at other times of the year. Timing of the whale sharks' migration to and from Ningaloo coincides with the mass coral spawning period when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo Reef
- seasonal shark aggregations and manta rays, commonly found in the area with a permanent population of manta rays (*Manta alfredi*) inhabiting the Ningaloo Reef. Numbers are boosted periodically by roaming and seasonal animals. Small aggregations coincide with small pulses of target prey and the spawning events of many reef inhabitants, while larger aggregations coincide with major seasonal spawning events. The number of species in the Ningaloo Reef area peaks during autumn, which corresponds to coral spawning, and during spring which corresponds with the crab spawning event (McGregor n.d.)
- annual mass coral spawning on Ningaloo Reef. Synchronous, multi-species spawning of tropical reef corals occurs during a brief predictable period in late summer/early autumn generally seven to nine nights after a full moon on neap, nocturnal ebb tides March/April each year (Rosser and Gilmour 2008, Taylor and Pearce 1999)
- large coral slicks generally forming over shallow reef areas in calm conditions. Note: Minor spawning activities occur on the same nights after the February and April full moons, and in some years the mass spawning event occurs after the April full moon (Simpson et al. 1993)
- marine mammals such as dugong and small cetacean populations frequenting or residing in nearshore waters. Dugong numbers in Ningaloo Marine Park are considered to be ~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
- 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 as isolated rookeries on the Muiron and Sunday Islands.

In addition to the ecological and conservation values, the Ningaloo Marine Park has a number of social values including culture heritage (both Indigenous and maritime; Section 4.6.1) and marine-based tourism and recreation (water-sports and fishing) (Section 4.6.5). The Ningaloo

Marine Park (State Waters) is contiguous with the Ningaloo AMP (Figure 4-17) and The Ningaloo Coast was listed as a National Heritage Place on 6 January 2010 due to its extraordinary natural qualities and Indigenous Significance (DoEE 2019b).

Ningaloo Shoreline, Shallow Subtidal Reef and Intertidal Habitats

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

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

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

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

Avicennia marina, *Rhizophora stylosa* and *Bruguiera exaristata*. *A. marina* is most common and widespread. This habitat supports a diverse community of invertebrate fauna including gastropods, crabs and burrowing worms, and is also a nursery area for the juveniles of many species of reef fish

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

In addition to the ecological and conservation values, the Ningaloo Marine Park has a number of social values including cultural heritage (both Indigenous and maritime; Section 4.6.1) and marine-based tourism and recreation (water sports and fishing; Section 4.6.5). The Ningaloo Marine Park (State Waters) is contiguous with the Ningaloo AMP (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 that could impact these values. Values that could be impacted from the Petroleum Activities Program and the associated management objectives outlined in the Management Plan are detailed in Table 4-13.

Table 4-13: 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, or • hydrocarbon spills from passing ships	To ensure that the water quality of the reserves is maintained at a level that supports and maintains the areas ecological and social values.	Credible risks and impacts to these receptors are considered in Section 6.8
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.	

Value potentially impacted by Petroleum Activities Program	Relevant existing and potential threats identified in Management Plan	Associated management objectives	Relevant EP section
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			
No specific threats/management objectives identified for the Petroleum Activities Program			

Muiron Islands: Shallow Subtidal, Intertidal and Shoreline Habitats

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

4.7.2.4 Gascoyne AMP

The Gascoyne AMP covers ~81,766 km^2 and includes waters from <15 m to 6000 m deep. Conservation values identified within the park include (DoEE n.d., DNP 2018):

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

The park contains three key conservation 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 seafloor feature)
- Exmouth Plateau (unique seafloor feature associated with internal wave generation)
- continental slope demersal fish communities (high species diversity and endemism; this is the most diverse slope bioregion in Australia, with >500 species recorded, of which 76 are endemic to the area).

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

4.7.3 Pilbara Coast and Islands

4.7.3.1 Dampier Archipelago (including Burrup Peninsula) National Heritage Place

The Dampier Archipelago, which is ~1550 km north of Perth, was included on the National Heritage List on 3 July 2007 (DoEE n.d.). The National Heritage Place is ~36,860 ha, with the Burrup Peninsula comprising ~400 km^2 (DoEE 2019). The Burrup Peninsula is made up of islands, reefs, shoals, channels and straits. The National Heritage Place includes Australia's greatest collection of petroglyphs and a high density of stone sites (DoEE n.d.). The rock engravings illustrate the evolution of societies and the environment over time, including engravings of humans, animals and geometric designs (DoEE n.d.). The stone arrangements include standing stones, stone pits and circular stone arrangements.

4.7.3.2 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 (>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 ~125 km south-south-west of the Operational Area.

The Middle Island Group, which is ~156 km south of the Operational Area, includes the Mary Anne Reefs and neighbouring small islands. The Southern Island Group includes Serrurier, Bessieres and Thevenard Islands Nature Reserves and is ~233 km south-west of the Operational Area. The nearshore habitats of these islands generally comprise fringing reefs on the seaward side and wide intertidal sand flats on the leeward side. Despite generally high turbidity in the area and relatively low abundance, hard coral biodiversity is high (Chevron Australia 2010). The coral community structure within this area, and others within the region, is highly temporally variable due to cyclonic activity.

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

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

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

4.7.4 Rowley Shoals

4.7.4.1 Rowley Shoals Marine Park

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

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

- wilderness: a remote and isolated location with minimal infrastructure and low visitor levels provides a wilderness experience for visitors.

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

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

4.7.4.2 Argo-Rowley Terrace AMP

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

The ecological and conservation values include (DoEE n.d., DNP 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 4.7.5):
  - 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.

4.7.5 Key Ecological Features

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

KEFs meet one or more of the following criteria:

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

- biodiversity and endemism (species which only occur in a specific area), or
- a unique seafloor feature, with known or presumed ecological properties of regional significance.

One KEF overlaps the Operational Area, with an additional five KEFs within or intersecting the EMBA (Table 4-12 and Figure 4-18).

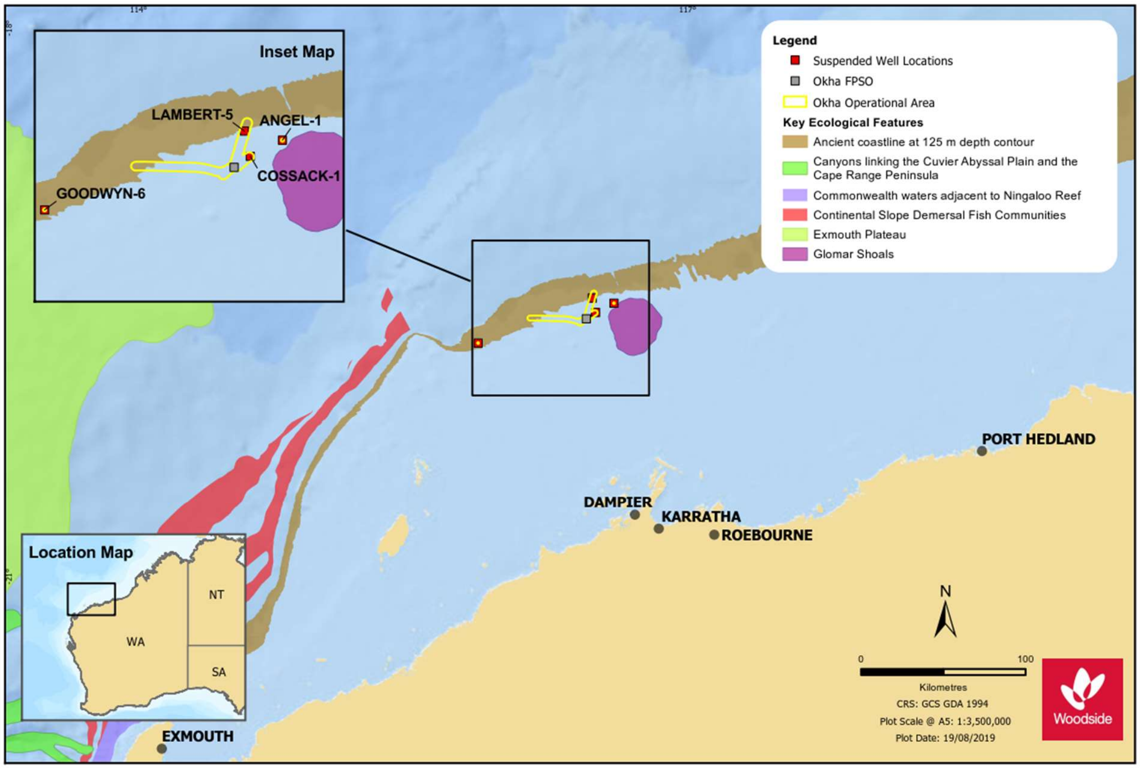

Figure 4-18: Key ecological features in relation to the Operational Area

4.7.5.1 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 NWMR 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 KEF overlaps the Operational Area, extending along a line approximated by the 125 m isobath (Figure 4-18). The ancient coastline is not continuous throughout the NWMR, and coincides with a well-documented eustatic stillstand at ~130 m worldwide (Falkner et al. 2009b).

Where the ancient coastline provides areas of hard substrate, it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat (Falkner et al. 2009b). 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, these habitat types are not unique to the coastline as they are widespread on the upper shelf (Falkner et al. 2009b).

4.7.5.2 Continental Slope Demersal Fish Communities

The continental slope demersal fish communities in the region have been identified as a KEF of the NWS Province (DSEWPaC 2012a); they are ~40 km west of the Operational Area. The continental slope between North West Cape and the Montebello Trough has been identified as one of the most diverse slope assemblages in Australian waters, with >508 fish species and the highest number of endemic species (76) of any Australian slope habitat (DEWHA 2008). Additional features relating to the fish populations of this area are:

- Continental slope demersal fish communities have been identified as a KEF of the NWMR due to the notable diversity of the demersal fish assemblages and high levels of endemism (DSEWPaC 2012a).
- The North West Cape region is a transition area for demersal shelf and slope fish communities between the tropical-dominated communities to the north and temperate communities to the south (Last et al. 2005). The benthic shelf and slope communities offshore the North West Cape comprise both tropical and temperate fish species with a north–south gradient (DEWHA 2008).

The fish fauna of the North West Cape region, like the ichthyofauna of many regions, exhibit decreasing species richness with depth (Last et al. 2005). Fish species diversity has been shown to be positively correlated with habitat complexity, with more complex habitats (e.g. coral reefs) typically hosting higher species richness than simpler habitats such as bare, unconsolidated muddy sediments (Gratwicke and Speight 2005). A total of 500 finfish species from 234 genera and 86 families have been recorded within the Ningaloo Marine Park, and 393 species were identified at study sites of the Muiron Islands (CALM 2005). The offshore sediment habitats of the Operational Area are expected to support lower fish species richness than other shallower, more complex habitats in the coastal areas of the region.

4.7.5.3 Glomar Shoal

Glomar Shoal is ~3 km south-east of the Operational Area. This submerged shoal is a large (215 km^2) complex bathymetrical feature on the outer continental shelf off the Pilbara. Glomar Shoal rises gently on the south-west side of the reef from 80 m depth to a single plateau at 40 m depth. The north-eastern side of the reef rises steeply from 70 m to 40 m depth. The shoal is relatively shallow, with water depths reaching 22–28 m at its shallowest point. Together with Rankin Bank, this remote shallow-water area represent regionally unique habitats and is likely to play an important role in the productivity of the Pilbara region (AIMS 2014b, Wahab et al. 2018).

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

Benthic habitats of Glomar Shoal vary with depth and are characterised by coarse unconsolidated sediment at depths >60 m to hard substrate supporting benthic communities comprising spare hard and soft corals sponges and macroalgae at depths <40 m. Total cover of benthic taxa (hard coral, soft coral, sponges and other benthic biota) is highest at depths <40 m and decreases with depth (Wahub et al. 2018). At depths of 60–80 m benthic cover is low and ~2%, and at depths >80 m benthic cover is barely present with baseline survey data indicating 0.1% cover of benthic biota. The results of a baseline survey and habitat modelling undertaken by AIMS in 2013 indicate that the portion of Glomar Shoal overlapping the Operational Area comprises soft sediment seabed and not areas of higher, phototrophic benthic biota (AIMS 2014). Structurally complex biodiverse benthic habitats are mainly found within the north-eastern portion of Glomar Shoal (AIMS 2014, Wahab et al. 2018).

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

4.7.5.4 Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals

Mermaid Reef and the Commonwealth Waters surrounding the Rowley Shoals KEF is ~308 km from the Operational Area, adjacent to the three nautical mile State Waters limit surrounding Clerke and Imperieuse reefs; it includes the Mermaid Reef National Nature Park (Section 4.7.5).

4.7.5.5 Exmouth Plateau

The Exmouth Plateau is a large, mid-slope, continental margin plateau off the north-west coast of Australia, ~155 km west of the Operational Area. It ranges in depth from ~800 m to 3500 m and is a major structural element of the Carnarvon Basin (Miyazaki and Stagg 2013). The plateau is bordered by 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 between January and 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 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 NWMR; 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 (including whale sharks and cetaceans) are also known to pass through the region.

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).

4.7.5.6 Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula

The canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF (the Canyons KEF) are off the north-west coast of Australia, ~231 km south-west of the Operational Area. The canyons 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: 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 Australia) and internal waves (Taylor and Pearce 1999, Woo et al. 2006).

Falkner et al. (2009) identified 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. Falkner et al. (2009) noted 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 region, with seabed habitats and deepwater biota being typical and representative in the wider region. 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 (DoEE n.d.).

4.7.5.7 Commonwealth Waters Adjacent to Ningaloo Reef

The Commonwealth Waters adjacent to Ningaloo Reef KEF are ~278 km from the Operational Area and are adjacent to the three nautical mile State Waters limit along Ningaloo Reef. The KEF includes the Ningaloo AMP. See Section 4.7.2 for further information about the values and sensitivities associated with this KEF.

4.7.6 Other Sensitive Areas

4.7.6.1 Rankin Bank

Rankin Bank is on the continental shelf, ~21 km east of the Operational Area at the closest point. While Rankin Bank is not a KEF, it is, along with Glomar Shoal, the only large complex bathymetrical feature on the outer western shelf of the west Pilbara, and represents habitats that are likely to play an important role in the productivity and biodiversity of the Pilbara region (AIMS 2014b, Wahab et al. 2018). Rankin Bank comprises three submerged shoals delineated by the 50 m depth contour with water depths of ~18–30.5 m (AIMS 2014b).

Rankin Bank represents a diverse marine environment, predominantly comprising consolidated reef and algae habitat (~55% cover), followed by hard corals (~25% cover), unconsolidated sand/silt habitat (~16% cover), and benthic communities composed of macroalgae, soft corals, sponges and other invertebrates (~3% cover) (AIMS 2014b). Hard corals are a significant component of the benthic community of some parts of the bank, with abundance in the upper end of the range observed elsewhere on the submerged shoals and banks of north-west Australia, and have been shown to be more diverse and productive than those at Glomar Shoal (Heyward et al. 2012, Wahab et al. 2018).

Rankin Bank has been shown to support a diverse fish assemblage (AIMS 2014b); Wahab et al. (2018) suggested Rankin Bank is a refuge for fish species on the largely homogeneous benthic habitat in the middle to outer continental shelf in the NWS Province (Wahab et al. 2018). Rankin Bank has been shown to host more abundant and species-rich fish assemblages than Glomar Shoal, although differences in some measures of taxonomic diversity and distinctness were not significantly different (Wahab et al. 2018). This is consistent with studies showing a strong correlation between habitat diversity and fish assemblage species richness (Gratwicke and Speight 2005, Last et al. 2005).

The habitat surrounding Rankin Bank (<50 m deep) was mapped by AIMS on behalf of Woodside (2014c) and hosts filter feeding communities in areas of consolidated substrate interspersed by sand. Refer to Section 4.5.1.4 for information on filter feeding communities.

5. STAKEHOLDER CONSULTATION

5.1 Summary

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

5.2 Stakeholder Consultation Guidance

Woodside has followed the requirements of 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 NT Government to which the activities to be carried out under the Environment Plan, or the revision of the Plan, may be relevant.
- The Department of the responsible State Minister, or the responsible NT Minister.
- A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the Environment Plan, or the revision of the Plan.
- Any other person or organisation that the Titleholder considers relevant.

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

5.3 Stakeholder Consultation Objectives

In support of this EP, Woodside has sought to:

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

5.4 Stakeholder Expectations for Consultation

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

NOPSEMA:

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

- *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*

AFMA:

- *Petroleum industry consultation with the commercial fishing industry*

Commonwealth Department of Agriculture and Water Resources:

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

WA Department of Primary Industries and Regional Development:

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

WA Department of Transport

- *Offshore Petroleum Industry Guidance Note*

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

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

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

Stakeholder	Relevant to activity	Reasoning
Commonwealth Government department or agency		
Australian Customs Service – Border Protection Command (ACS)	Yes	Responsible for coordinating maritime security.
Australian Fisheries Management Authority (AFMA)	Yes	Responsible for managing Commonwealth fisheries. There has been no recent effort by Commonwealth fishery licence holders in the area.
Australian Hydrographic Service (AHS)	Yes	Responsible for maritime safety and Notice to Mariners.
Australian Maritime Safety Authority (AMSA)	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth Waters.
Department of Agriculture and Water Resources (DAWR)	Yes	Responsible for implementing Commonwealth policies and programs to support the agriculture, fisheries, food and forestry industries. Although the proposed activity is unlikely to impact Commonwealth fisheries as fishing effort has historically occurred outside the Operational Area (Table 4-9), Woodside notes DAWR's interest in biosecurity matters, such as the introduction of invasive marine species (IMS), and has provided information about the proposed activity.
Department of Defence	No	The Operational Area is not within a Defence activity area.
Department of the Environment and Energy (DoEE)	No	Responsible for designing and implementing Commonwealth policy and programs to protect and conserve the environment, water and heritage, promote climate action, and provide adequate, reliable and affordable energy. The proposed activity does not trigger any of the DoEE's functions, interests or activities.
Department of Industry, Innovation and Science (DIIS)	Yes	Required to be consulted under the Regulations.
Director of National Parks (DNP)	Yes	Has responsibility for the management of AMPs and therefore requires an awareness of activities that occur within, and 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 where 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).
WA Government department or agency		
Department of Biodiversity, Conservation and	No	Responsible for managing WA's parks, forests and reserves. Planned activities do not impact DBCA's functions, interests or activities.

Stakeholder	Relevant to activity	Reasoning
Attractions(DBCA), Parks and Wildlife Service		
Department of Mines, Industry Regulation and Safety (DMIRS)	Yes	Required to be consulted under the Regulations.
Department of Primary Industries and Regional Development (DPIRD)	Yes	Responsible for managing State fisheries.
Department of Transport (DoT)	Yes	Legislated responsibility for oil pollution response in State Waters.
Commonwealth fisheries*		
Southern Bluefin Tuna Fishery	No	Fishery overlaps the Operational Area, but there has been no recent fishing effort in the area.
Western Skipjack Fishery	No	Fishery overlaps the Operational Area, but there has been no recent fishing effort in the area.
Western Tuna and Billfish Fishery	Yes	Fishery overlaps the Operational Area, and there is potential for interaction with this fishery's licence holders.
State fisheries*		
Mackerel Managed Fishery – Pilbara (Area 2)	Yes	Fishery overlaps the Operational Area and there has been recent fishing effort.
Marine Aquarium Managed Fishery	No	Fishery overlaps the Operational Area, but typical water depth for fishing is not relevant to the area.
Onslow Prawn Managed Fishery	No	Fishery overlaps the Operational Area, but typical water depth for fishing is not relevant to the area.
Pearl Oyster Managed Fishery	No	Zone 1 of the fishery overlaps the Operational Area, but water depth for diver-based fishing is not relevant to the area.
Pilbara Demersal Scalefish Fisheries		
• Pilbara Trawl Fishery	Yes	Fishery overlaps the Operational Area and there has been recent fishing effort.
• Pilbara Trap Fishery	Yes	Fishery overlaps the Operational Area and there has been recent fishing effort.
• Pilbara Line Fishery	Yes	Fishery overlaps the Operational Area and there has been recent fishing effort.
South West Coast Salmon Managed Fishery	No	Fishery overlaps the Operational Area, but there has been no recent fishing effort in the area.

Stakeholder	Relevant to activity	Reasoning
Specimen Shell Managed Fishery	No	Fishery overlaps the Operational Area, but shell collection method and typical water depth for collection is not relevant to the area.
West Australian Abalone Fishery	No	Fishery overlaps the Operational Area, but typical water depth for fishing is not relevant to the area.
West Coast Deep Sea Crustacean Managed Fishery	No	Fishery overlaps the Operational Area, but there has been no recent fishing effort in the area.
Industry		
BP Developments	Yes	Adjacent Titleholder
Mobil Australia	Yes	Adjacent Titleholder
Santos	Yes	Adjacent Titleholder
Sapura Exploration and Petroleum	Yes	Adjacent Titleholder
Industry representative organisations		
Australian Petroleum Production and Exploration Association (APPEA)	Yes	Represents the interests of oil and gas explorers and producers in Australia.
Commonwealth Fisheries Association (CFA)	Yes	Represents the interests of commercial fishers with licences in Commonwealth Waters. Activities are unlikely to impact commercial fishers.
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	No	Represents the interests of recreational fishers in Western Australia. Activities are unlikely to impact recreational fishers given the distance from shore.
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 these State fisheries: • Pilbara Trawl Fishery • Pilbara Trap Fishery • Pilbara Line Fishery • Mackerel Fishery

Stakeholder	Relevant to activity	Reasoning
Other Stakeholders		
Charter boat operators	No	There has been no recent fishing effort in the Operational Area by charter boat operators.

** 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 and water depth. Table 4-9 provides a detailed assessment of Commonwealth and State fisheries within or adjacent to the Operational Area.*

5.5 Stakeholder Consultation Plan

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

In addition, Woodside published a consultation Information Sheet at www.woodside.com.au/sustainability/transparency/consultation-activities and provided a toll-free 1800 phone number to support consultation activities.

Table 5-2: Stakeholder consultation activities

Stakeholder	Date	Consultation activities
Commonwealth Government department or agency		
ACS	8 July 2019	Email advising of proposed activity and consultation Information Sheet.
AFMA	28 August 2019	Email advising of proposed activity, consultation Information Sheet and Commonwealth fisheries map relevant to proposed activity.
AHS	8 July 2019	Email advising of proposed activity, consultation Information Sheet and shipping lane map relevant to proposed activity.
AMSA (maritime safety)	8 July 2019	Email advising of proposed activity, consultation Information Sheet and shipping lane map relevant to proposed activity.
AMSA (marine pollution)	27 August 2019	Email advising of proposed activity and provide copy of the Oil Pollution First Strike Plan
DAWR	2 August 2019	Email and Information Sheet provided advising of proposed activity. Advice provided that no expected impacts from planned activities to Commonwealth fisheries. Information provided in line with DAWR consultation expectations on prevention of the introduction of IMS.
DIIS	8 July 2019	Email advising of proposed activity and consultation Information Sheet.
DNP	20 September 2019	Email advising of proposed activity and consultation Information Sheet.

Stakeholder	Date	Consultation activities
	26 June 2020	Email advising of a revised list of AMPs which have the potential to be contacted in the event of a worst-case hydrocarbon spill (refer thresholds for planning area for scientific monitoring in Table 4-1).
WA Government department or agency		
DMIRS	8 July 2019	Email advising of proposed activity and consultation Information Sheet.
DPIRD	8 July 2019	Email advising of proposed activity, consultation Information Sheet and State fisheries map relevant to proposed activity. Offer to meet in person.
	10 July 2019	Follow-up phone call up with DPIRD.
	15 August 2019	Follow-up email of proposed activity, consultation Information Sheet and State fisheries map relevant to proposed activity. Offer to meet in person.
DoT	8 July 2019	Email advising of proposed activity and commitment for further consultation once oil spill planning for this activity is finalised.
	27 August 2019	Email advising of proposed activity and provide copy of the Oil Pollution First Strike Plan (Appendix H)
Commonwealth fisheries*		
Western Tuna and Billfish Fishery	28 August 2019	Email advising of proposed activity, consultation Information Sheet and Commonwealth fisheries map relevant to proposed activity.
State fisheries*		
Mackerel Managed Fishery – Pilbara (Area 2)	8 July 2019	Email/letter to licence holders providing information on potential impacts to fishers and Woodside's proposed management and mitigation measures, a consultation Information Sheet and State fisheries map relevant to proposed activity.
Pilbara Demersal Scalefish Managed Fisheries • Pilbara Trawl Fishery • Pilbara Trap Fishery • Pilbara Line Fishery	8 July 2019	Email/letter to licence holders providing information on potential impacts to fishers and Woodside's proposed management and mitigation measures, a consultation Information Sheet and State fisheries map relevant to proposed activity.
Industry		
BP Developments	8 July 2019	Email advising of proposed activity, consultation Information Sheet and titles map relevant to proposed activity.

Stakeholder	Date	Consultation activities
Mobil Australia	8 July 2019	Email advising of proposed activity, consultation Information Sheet and titles map relevant to proposed activity.
Santos	8 July 2019	Email advising of proposed activity, consultation Information Sheet and titles map relevant to proposed activity.
Sapura Exploration and Petroleum	8 July 2019	Email advising of proposed activity, consultation Information Sheet and titles map relevant to proposed activity.
Industry representative organisations		
APPEA	8 July 2019	Email advising of proposed activity, consultation Information Sheet and titles map relevant to proposed activity.
CFA	28 August 2019	Email advising of proposed activity, consultation Information Sheet and Commonwealth fisheries map relevant to proposed activity.
PPA	8 July 2019	Email advising of proposed activity including potential impacts to commercial fishers and proposed management/mitigation measures, consultation Information Sheet and State fisheries map relevant to proposed activity.
WAFIC	8 July 2019	Email advising of proposed activity including potential impacts to commercial fishers and proposed management/mitigation measures, consultation Information Sheet and State fisheries map relevant to proposed activity.

Copies of communications material outlined in Table 5-2 is included in Appendix F.

5.6 Consultation Feedback

A summary of stakeholder feedback and Woodside's responses is outlined in Table 5-3**.**

Table 5-3: Assessment stakeholder consultation feedback

Stakeholder	Stakeholder feedback	Woodside response
Commonwealth Government department or agency		
ACS	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.
AFMA	No feedback received.	Consultation Information Sheet, and fisheries map provided. Woodside considers the level of consultation to be adequate.
AHO	No feedback received.	Woodside will notify the AHO no less than four working weeks before operations commence.

Stakeholder	Stakeholder feedback	Woodside response
		Woodside considers the level of consultation to be adequate.
AMSA	On 8 July 2019 AMSA emailed Woodside requesting the Master to email AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence and provided details of information required by the Centre in that communication. AMSA requested that the AHS be contacted through datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners. AMSA provided advice on obtaining vessel traffic plots, including digital data sets and maps.	On 15 August 2019 Woodside emailed AMSA and confirmed that it will notify AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence. Woodside advised it will notify the AHO no less than four working weeks before operations commence. Woodside noted AMSA's advice on vessel traffic information.
	On 21 August 2019 AMSA emailed Woodside acknowledging receipt of Woodside's advice and that a case number had been allocated.	On 23 August 2019 Woodside emailed AMSA clarifying whether its email was correct in response to advice about the Okha Operations EP. No further advice has been received from AMSA. Woodside considers the level of consultation to be adequate.
DAWR	No feedback received.	Woodside engaged relevant Commonwealth fishery licence holders, as well as their representative organisation. Woodside has addressed maritime biosecurity and commonwealth fishing related issues in Section 6 of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
DIIS	No feedback received.	Woodside engaged DIIS as is required under the Regulations. Assessment of this EP will be conducted by NOPSEMA as the offshore regulator. Woodside considers the level of consultation to be adequate.
DNP	On 24 March 2020, DNP advised that planned activities do not overlap any Australian Marine Parks. It advised it does not require any further notification unless the activity changes and results in an overlap with or new impact to a marine park, or for emergency responses.	Woodside notes the DNP feedback and will consult it should the activity change and impact Australian Marine Parks, or for emergency responses.
	On 30 June 2020, DNP emailed Woodside acknowledging receipt of Woodside's revised list of AMPs and confirmation that DNP will be notified	Woodside notes DNP feedback.

Stakeholder	Stakeholder feedback	Woodside response
	in the event an environmental incident which may impact on the values of any AMP.	
WA Government department or agency		
DMIRS	On 19 July 2019 DMIRS emailed Woodside noting the activity advice and that no further information was required.	Woodside notes DMIRS' feedback.
DPIRD	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided to DPIRD. Follow-up phone call on 10 July 2019 and follow-up email sent on 15 August 2019. Woodside considers the level of consultation to be adequate.
DoT	On 17 July 2019 requested to be advised in accordance with its Guidance Note on oil pollution if there were any changes to Oil Spill Contingency Plans/OPEPs or change to spill risk.	Woodside committed to providing information to DoT if there were any changes to Oil Spill Contingency Plans/OPEPs or change to spill risk.
Commonwealth fisheries		
Western Tuna and Billfish Fishery Licence Holders	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided. Woodside considers the level of consultation to be adequate.
State fisheries		
Mackerel Managed Fishery – Pilbara (Area 2) Licence Holders	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided. Woodside considers the level of consultation to be adequate.
Pilbara Demersal Scalefish Managed Fisheries Licence Holders:		
• Pilbara Trawl Fishery	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided.

Stakeholder	Stakeholder feedback	Woodside response
		Woodside considers the level of consultation to be adequate.
• Pilbara Trap Fishery	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided. Woodside considers the level of consultation to be adequate.
• Pilbara Line Fishery	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided. Woodside considers the level of consultation to be adequate.
Industry		
BP Developments	No feedback received.	Consultation Information Sheet and bespoke maps provided. Woodside considers the level of consultation to be adequate and commits to ongoing consultation.
Mobil Australia	No feedback received.	Consultation Information Sheet and bespoke maps provided. Woodside considers the level of consultation to be adequate and commits to ongoing consultation.
Santos	No feedback received.	Consultation Information Sheet and bespoke maps provided. Woodside considers the level of consultation to be adequate and commits to ongoing consultation.
Sapura Exploration and Petroleum	No feedback received.	Consultation Information Sheet and bespoke maps provided. Woodside considers the level of consultation to be adequate and commits to ongoing consultation.
Industry representative organisations		
APPEA	No feedback received.	Consultation Information Sheet including map provided. Woodside considers the level of consultation to be adequate and commits to ongoing consultation.
CFA	No feedback received.	Consultation Information Sheet and Commonwealth fisheries map provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Stakeholder feedback	Woodside response
PPA	No feedback received.	Consultation Information Sheet, map and bespoke information on potential fisheries impacts and mitigation and management strategies provided. Woodside considers the level of consultation to be adequate.
WAFIC	On 22 July WAFIC emailed Woodside noting that it would assess Woodside's advice under arrangements prior to WAFIC advice on 11 July 2019 that advice would be provided on a fee-for-service basis.	On 16 August 2019 Woodside responded to WAFIC.
	WAFIC requested that proposed stakeholder information was sent to WAFIC prior to consultation with commercial fishers.	Woodside notes WAFIC's request.
	WAFIC requested that Woodside's Pilbara Line fishery map be amended to be clear that the fishery was open and active.	Woodside notes WAFIC's advice and will update maps for future consultation activities.
	WAFIC advised that Woodside should contact commercial fishers in Area 2 only of the Mackerel Managed Fishery.	Woodside advised it had obtained contact details for licence holders for Areas 1, 2 and 3 and will consult licence holders from relevant areas for future consultation activities.
	WAFIC requested greater clarity on exclusion zones, specifically: • Confirmation that all exclusion zones were pre-existing. • Advice on start and finish dates if exclusion zones were temporary. • Confirmation on the meaning of the term 'Operational Area' in Woodside's consultation materials. • Confirmation that the 'petroleum safety zone' was pre-existing.	Woodside confirmed: • All exclusion zones were pre-existing • There were no temporary exclusion zones but Woodside would advise timing if needed for future petroleum activities • There was a 1500 m Operational Area around the Okha facility and subsea infrastructure, including wells and flowlines and the gas export line, which fishers can access • The 500 m PSZ was pre-existing
	WAFIC noted Woodside's use of DP vessels and seabed benefits but requested further information on seabed disturbances and underwater noise, specifically impacts of noise from DP vessels on fish hearing, feeding, spawning, behaviours and dispersal. WAFIC claimed that increase in noise was a significant issue in the Great Australian Bight for the proposed Stromlo exploration drilling program.	Woodside provided references of scientific research on the potential impacts to fish from continuous noise sources, as well as estimated source levels from the Okha facility and DP vessels. It was not expected that demersal fish communities would be exposed to noise levels from the Okha or DP vessels that would cause a recoverable injury or a temporary threshold shift in hearing.

Stakeholder	Stakeholder feedback	Woodside response
		Woodside advised that there was no quantitative threshold for the potential behavioural effects of fish to underwater sound sources such as DP or vessel noise. It also advised that for the most sensitive fish type expected to be moderate within a range of hundreds of metres from the source. Mortality or injury to eggs and larvae from continuous sound sources was assessed as being 'low', regardless of the proximity to the source
	WAFIC requested additional information hydrocarbon release, specifically: • Advice if blowout preventers (BOPs) were in stock and on site? If not, the time it would it take to transport a BOP to site. • Advice on next options, such as capping stacks, if the use of BOPs were unsuccessful and the time it would it take to transport a capping stack to site. • Advice on planning and mobilisation of a standby rig if the above management measures were unsuccessful. WAFIC also sought Woodside's position on the establishment of a standby rig in a convenient /readily accessible location in the event of an emergency.	Woodside advised that its primary source control option for an unplanned hydrocarbon release for the Okha wells was ROV intervention followed by relief well drilling and/or subsea dispersant injection. Woodside advised that deployment of BOP stacks would not be considered as they can only be deployed using drilling rigs, which would not be allowed within a hydrocarbon release exclusion zone due to safety risk to personnel on the rig. Woodside advised that it is a signatory to a Memorandum of Understanding (MOU) between Australian offshore operators to provide mutual aid to facilitate and expedite mobilising a mobile offshore drilling unit for drilling a relief well if an unplanned hydrocarbon release were to occur. The MOU commits the signatories to share rigs, equipment, personnel and services to assist another operator if required. Woodside considers this an appropriate approach to access a drilling unit if required. The timeframe for relief well drilling is being evaluated as part of Woodside's oil spill planning and response mitigation assessment process.
	WAFIC expressed its expectation of the following items for support vessels and requested Woodside to include these in the EP: • Diversion around commercial fishing vessels and remaining clear of fishing gear. • Avoidance of close and/or disruptive engagement with any commercial fishing activity. • Avoid activities that would cause disruption to schooling fish.	Woodside advised that all vessels on charter to Woodside comply with the International Rules for the Prevention of Collision at Sea. In observance of good seamanship all support vessels will avoid any close and or disruptive engagement with any commercial fishing activity. Woodside advised that this statement will be incorporated into the EP.

Stakeholder	Stakeholder feedback	Woodside response
	WAFIC sought details on workforce, contractor and subcontractor communications and requested Woodside to include these in the EP, specifically: • Policy/processes regarding interacting and protecting the rights of active commercial fishers on the water. • Communication of EP processes across the workforce and how they are reviewed / audited.	Woodside advised that it provides campaign-specific EP inductions with each vessel chartered to ensure awareness of the key EP commitments. Woodside also maintains signed records of vessel crew contractors' participation in vessel marine inductions to ensure that all vessel crew are aware of Woodside's key commitments in the EP. Woodside's also has charterers instructions that describe the master's obligation to comply with all EP requirements, including campaign environmental compliance. Woodside advised that this statement will be incorporated into the EP.
	WAFIC sought details on recreational fishing from support/commercial vessels and requested Woodside to include these in the EP, specifically: • Confirmation from Woodside of a 'no fishing from support/commercial vessel' and that this policy would be enforced and communicated with contractors and subcontractors • Woodside's audit / compliance policy / process regarding recreational fishing on support/commercial vessels.	Woodside advised that it prohibits recreational fishing activities at Woodside terminals and supply bases or within a 500 m zone of a Woodside-operated facility. It also advised that contractors and subcontractors implement their own policies regarding recreational fishing from their vessels, some of which include a total ban.
	WAFIC sought details on post-spill activities, specifically: • Processes to quantitively assess any damage to fish and shellfish stocks. • Plans for bespoke stock assessments to develop baseline understanding of the NWS area. • Details of scientific studies to understand stock baseline data in the event of a spill. • Details of scientific studies to understand spawning baseline data in the event of a spill. • Details of baseline data to inform potential financial compensation in the event of a spill.	Woodside provided details of its scientific monitoring program (SMP), which would be implemented in the event of a Level 2 or 3 unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors is activated. The objectives of the SMP are to: • Assess the extent, severity and persistence of the environmental impacts from the spill event • Monitor subsequent recovery of impacted key species, habitats and ecosystems. The SMP comprises environmental monitoring programs for a range of physical-chemical (water and sediment) and biological (species and habitats) receptors. Woodside advised that in the event of a spill it would support the WA Government to assess contamination of any caught finfish and/or shellfish to assess fitness for consumption.

<table>
<tr><th>Stakeholder</th><th>Stakeholder feedback</th><th>Woodside response</th></tr>
<tr><td></td><td></td><td>Woodside also provided advice on the assessment on fish populations in the event of a spill, acknowledging challenges given the considerable natural fluctuations in population dynamics in the offshore environment.
Woodside advised it would consider implications for fishers in the unlikely event of a hydrocarbon spill on a case-by-case basis.</td></tr>
<tr><td></td><td>WAFIC sought details on Woodside’s learning and understanding of global oil spill events to inform planning for activities undertaken under the Okha EP given the isolated location of the facilities, specifically:
• Lessons learned from global spill events, especially in relation to emergency response preparedness and early control of oil loss.
• Expectations for the time for a rig to arrive at the location. WAFIC claimed that a standby / back-up rig should be anchored at a ‘best possible’ location in Australia or in WA’s case, possibly in Asian waters, adding that a long delay between a major spill event and the arrival of a backup rig is an unacceptable risk level that does not meet ALARP assessment.
• Woodside’s position on the permanent siting of a standby / backup rig at a suitable location in Australia for oil and gas industry use in the event of a major spill event.
• Woodside’s position on industry support and funding for a standby / backup rig being permanently parked in Australia to ensure a rapid response time in the event of an emergency.
• Woodside’s position on a more rapid response if a standby / backup rig was not permanently parked in Australia, including the development of a defined relationship with a backup rig located, for example, somewhere in Asia.</td><td>Woodside advised it was continually learning and updating its hydrocarbon spill process to ensure planning is commensurate to the risk and aligns with operator experience globally. This includes alignment with guidance provided by NOPSEMA, regular discussion with other oil and gas operators, lessons learnt from NOPSEMA inspections and engagement with oil spill response organisations.
Woodside confirmed it was still evaluating source control, well intervention and the relief well rig response activities in line with corporate source control procedures and the latest Industry Source Control Emergency Response Planning Guide for Subsea Wells, released by the International Association of Oil and Gas Producers and the International Petroleum Industry Environmental Conservation Association, January 2019 (Report 594). This included evaluating feasibility, effectiveness, cost and environmental benefit and timeframes for response activities.
Woodside advised that the EP for this activity demonstrated that the risks and impacts from an unplanned hydrocarbon release, and the associated response operations, were controlled to ALARP levels.
Woodside’s oil spill response plan (first strike plan; Appendix H) set out options for responding to a loss of well integrity in line with industry best practice, including measures that would be taken prior to relief well drilling and subject to risk assessment and approvals. This was supported by the MOU with other Australian offshore operators to share rigs, equipment, personnel and services if required.</td></tr>
</table>

Stakeholder	Stakeholder feedback	Woodside response
	WAFIC sought confirmation from Woodside on the respective sections of the EP that matters raised by WAFIC would be included.	Woodside advised it would provide WAFIC with the locations of where matters raised above would be included within the EP.

5.7 Ongoing Stakeholder Consultation

Woodside is committed to the engagements listed in Table 5-4, based on stakeholder feedback.

Table 5-4: Assessment ongoing stakeholder consultation

Stakeholder	Activity
AMSA	Woodside will notify AMSA's Joint Rescue Coordination Centre 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.

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

6.1 Overview

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

6.2 Analysis and Evaluation

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

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

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

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

The ENVID identified 8 impacts and 12 risks associated with the Petroleum Activities Program. Planned activities and unplanned events are summarised in Table 6-1 and Table 6-2.

The analysis and evaluation for the Petroleum Activities Program indicate that all the current environmental risks and impacts associated with the activity are reduced to ALARP and are of an acceptable level, as discussed further in Sections 6.6, 6.6.8, and 6.8.

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

Aspect	EP Section	Source of Impact	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Controlled Impact Classification	Residual Impact Level (ALARP controls in place)	Acceptability of Impact
Planned Activities (Routine and Non-routine)						
Physical presence: Disturbance to marine users	6.6.1	Presence of Okha FPSO and subsea infrastructure excluding and/or displacing other users from PSZ and Operational Area respectively.	Isolated social impact potentially resulting from interference with other sea users (e.g. commercial and recreational fishing, and shipping).	F	Social & Cultural – No lasting effect (<1 month). Localised impact not significant to area/item of cultural significance.	Broadly Acceptable
Physical presence: Disturbance to seabed	6.6.2	Presence of subsea infrastructure (including moorings) modifying marine habitats.	Localised modification of seabed habitat (formation of artificial reef) within Operational Area.	F	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Subsea operations, inspection, maintenance and repair activities resulting in disturbance to seabed	Slight, short-term modification of seabed habitat within Operational Area with slight short-term impacts to water quality and benthic communities.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	Broadly Acceptable
Routine acoustic emissions: Generation of noise during routine operations	6.6.3	Noise generated within the Operational Area from: • Okha FPSO and associated infrastructure • vessels and IMMR activities • helicopters.	Localised behavioural impacts to marine fauna around and within the Operational Area with no lasting effect.	F	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
Routine and non-routine discharges: Discharge of hydrocarbons and chemicals during subsea operations and activities	6.6.4	Discharge of subsea control fluids.	Slight, short-term impacts to water quality and benthic communities within Operational Area.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	Broadly Acceptable
		Discharge of hydrocarbons remaining in subsea pipework and equipment as a result of subsea intervention works.	Slight, short-term decrease in water quality at release location during IMMR activities.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	Broadly Acceptable
		Discharge of chemicals remaining in subsea pipework and equipment, or the use of chemicals for subsea IMMR activities.	Localised decrease in water quality at release location during IMMR activities with no lasting effect.	F	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of minor fugitive hydrocarbon/chemicals from wells and subsea equipment.	Localised decrease in water quality around subsea system within Operational Area with no lasting effect.	F	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
Routine and non-routine discharges: Produced water	6.6.5	Discharge of PW from FPSO.	Slight short-term, localised decrease in water quality, marine sediments and marine biota.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	Broadly Acceptable
Routine and non-routine discharges: Discharges from utility systems and drains	6.6.6	Discharge of sewage, greywater and putrescible waste from FPSO and vessels to the marine environment.	Localised decrease in water quality (increased nutrients and biological oxygen demand) with no lasting effect.	F (Cumulative E)	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of deck water from FPSO and bilge water from vessels to the marine environment.	Localised decrease in water quality at the discharge location with no lasting effect.	F (Cumulative E)	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of brine from vessels and FPSO to the marine environment.	Localised decrease in water quality at the discharge location with no lasting effect.	F (Cumulative E)	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of seawater systems (including cooling water) from FPSO and vessels to the marine environment.	Localised increase in salinity at the discharge location with no lasting effect.	F (Cumulative E)	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
Routine and non-routine atmospheric emissions: Fuel combustion, flaring and fugitives	6.6.8	FPSO and vessel fuel combustion emissions, FPSO operational flaring and fugitive emissions	Localised decrease in air quality, limited to the airshed local to the facility with no lasting effect.	F	Environment – No lasting effect (<1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable

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

Table 6-2: Environmental risk analysis summary of unplanned events (including MEEs)

Aspect	EP Section	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP Section for details)	Risk Rating				Acceptability of Risk
				Consequence Classification	Potential Consequence/Level of Impact	Likelihood	Risk Rating	
Unplanned Events (Accidents/Incidents)								
Unplanned hydrocarbon or chemical release: Hydrocarbon release during bunkering/refuelling and chemical transfer, storage and use	6.7.1	Accidental spill of hydrocarbons to the environment during bunkering/refuelling.	Potential minor short-term impacts to the marine environment, including decrease in water quality and minor impacts to marine biota.	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	2	M	Broadly acceptable
		Accidental discharge of chemicals to the marine environment from storage, use or transfer.	Potential slight, short-term impact to the marine environment, including the potential for slight impacts to marine biota.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	4	M	Broadly acceptable
Unplanned discharges: Waste management	6.7.2	Incorrect disposal or accidental discharge of non-hazardous and hazardous waste to the marine environment.	Potential for isolated, slight, short-term impacts to marine biota with no lasting effect.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	2	M	Broadly acceptable
Physical presence: Vessel interaction with marine fauna	6.7.3	Physical presence of vessels resulting in collision with marine fauna.	Potential injury or death of marine fauna (single animal), including protected species. No lasting effect to populations.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	1	L	Broadly acceptable
Physical presence: Introduction of IMS	6.7.4	Invasive species in vessel ballast tanks or on vessels/ submersible equipment.	Potential for minor impact to marine ecosystems.	E	Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	1	L	Broadly acceptable
Unplanned Events (Accidents/Incidents) – MEEs								
Unplanned hydrocarbon release: Loss of well containment (MEE-01)	6.8.3	Release of hydrocarbons resulting from loss of subsea well containment.	Potential significant impacts to the marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users.	A	Environment – Catastrophic, long-term impact (>50 years) on highly valued ecosystems, species, habitats or physical or biological attributes.	0	M	Acceptable if ALARP

Aspect	EP Section	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP Section for details)	Risk Rating				Acceptability of Risk
				Consequence Classification	Potential Consequence/Level of Impact	Likelihood	Risk Rating	
Unplanned hydrocarbon release: Subsea equipment loss of containment (MEE-02) [5]	6.8.4	Release of hydrocarbons resulting from subsea equipment loss of containment.	Potential significant impacts to the marine environment. Disruption to marine fauna, including protected species. Potential long-term interference with or displacement of other sea users.	C	Environment – Moderate, medium-term impact (2–10 years) on ecosystems, species, habitat or physical or biological attributes.	2	M	Acceptable if ALARP
Unplanned hydrocarbon release: Topsides loss of containment (MEE-03) [6]	6.8.5	Hydrocarbon release from topsides process equipment to the marine environment and atmosphere.	Potential significant impacts to the marine environment, including disruption to marine fauna (including protected species), and potential short-term interference with or displacement of other sea users.	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Acceptable if ALARP
		Hydrocarbon release from topsides non-process equipment to the marine environment.	Potential significant impacts to the marine environment, including disruption to marine fauna (including protected species), and potential short-term interference with or displacement of other sea users.	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Acceptable if ALARP
Unplanned hydrocarbon release: Offtake equipment loss of containment (MEE-04) [5]	6.8.6	Hydrocarbon release from Okha FPSO offtake equipment to the marine environment and atmosphere.	Potential significant impacts to the marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users.	C	Environment – Moderate, medium-term impact (2–10 years) on ecosystems, species, habitat or physical or biological attributes.	1	M	Acceptable if ALARP
Unplanned hydrocarbon release: Cargo tank loss of containment (MEE-05)	6.8.7	Hydrocarbon release caused by a cargo tank loss of containment.	Potential significant impacts to the marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users.	A	Environment – Catastrophic, long-term impact (>50 years) on highly valued ecosystems, species, habitats or physical or biological attributes.	1	H	Acceptable if ALARP
Unplanned hydrocarbon release: Loss of structural integrity (MEE-06)	6.8.8	Hydrocarbon release caused by a loss of structural integrity, leading to: • MEE-02 – Subsea flowline and riser loss of containment • MEE-03 – Topsides loss of containment • MEE-04 – Offtake equipment loss of containment • MEE-05 –FPSO Cargo tank loss of containment. Cargo tank loss of containment selected as bounding case.	Potential significant impacts to the marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users.	A	Environment – Catastrophic, long-term impact (>50 years) on highly valued ecosystems, species, habitats or physical or biological attributes.	1	H	Acceptable if ALARP
Unplanned hydrocarbon release: Loss of marine vessel separation (MEE-07)	6.8.9	Hydrocarbon release caused by a loss of marine vessel separation, leading to: • MEE-02 – Subsea flowline and riser loss of containment • MEE-03 – Topsides loss of containment • MEE-04 – Offtake equipment loss of containment	Potential significant impacts to the marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users.	A	Environment – Catastrophic, long-term impact (>50 years) on highly valued ecosystems, species, habitats or physical or biological attributes.	1	H	Acceptable if ALARP

[5] MEE based on reputational risk
[6] Whilst environment consequence does not meet definition as standalone MEE, scenario and bowtie assessment have been retained as a means of articulating causes and ALARP controls to prevent escalation to other MEEs

Aspect	EP Section	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP Section for details)	Risk Rating				Acceptability of Risk
				Consequence Classification	Potential Consequence/Level of Impact	Likelihood	Risk Rating	
		• MEE-05 – Okha FPSO Cargo tank loss of containment.						
Unplanned hydrocarbon release: Loss of control of suspended load from facility lifting operations (MEE-08)	6.8.10	Hydrocarbon release from subsea equipment to the marine environment and atmosphere (MEE-02).	Potential significant impacts to the marine environment. Disruption to marine fauna, including protected species. Potential long-term interference with or displacement of other sea users.	C	Environment – Moderate, medium-term impact (2–10 years) on ecosystems, species, habitat or physical or biological attributes.	1	M	Acceptable if ALARP
		Hydrocarbon release from topsides equipment to the marine environment and atmosphere (MEE-03).	Potential significant impacts to the marine environment, including disruption to marine fauna (including protected species), and potential short-term interference with or displacement of other sea users.	D	Environment – Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Acceptable if ALARP

6.2.1 Cumulative Impacts

Woodside has assessed the cumulative impacts of the Petroleum Activities Program in relation to other relevant petroleum activities that could realistically result in overlapping temporal and spatial extents. Other facilities located close to the Operational Area include NRC, Angel and GWA (distances to these facilities are outlined in Section 4.6.7). However, given environmental risks and impacts from the Petroleum Activities Program are concentrated around the Okha FPSO, the potential for cumulative impacts is considered to be low. Cumulative impacts are discussed for sources of risk and impacts where such impacts were deemed to be credible.

6.3 Environmental Performance Outcomes, Standards and Measurement Criteria

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

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

The EPOs, EPSs and MC specified are consistent with legislative requirements and Woodside's standards and procedures. They have been developed based on the legislation, codes and standards, good industry practices and professional judgement outlined in Sections 2.6.1.4 and 2.8, as part of the acceptability and ALARP justification process.

The EPOs, EPSs and MC are presented throughout this section and in Appendix D. A breach of these EPOs or EPSs constitutes a 'Recordable Incident' under the Environment Regulations (refer to Section 7.7.5).

6.4 Presentation

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

<table>
<tr><th colspan="15">Context
Description of the context for the impact/risk. Regulation 13(1, 13(2) and 13(3)</th></tr>
<tr><td>Description of the Activity – Regulation 13(1)</td><td colspan="6">Description of the Environment – Regulations 13(2)(3)</td><td colspan="8">Consultation – Regulation 11A</td></tr>
<tr><th colspan="15">Impacts and Risks Evaluation Summary
Summary of ENVID outcomes</th></tr>
<tr><td rowspan="2">Source of Risk
Regulation 13(1)</td><td colspan="7">Environmental Value Potentially Impacted
Regulations 13(2)(3)</td><td colspan="7">Evaluation
Section 2</td></tr>
<tr><td>Soil and Groundwater</td><td>Marine Sediment</td><td>Water Quality</td><td>Air Quality (incl Odour)</td><td>Ecosystems/ Habitat</td><td>Species</td><td>Socioeconomic</td><td>Decision Type</td><td>Consequence/Impact</td><td>Likelihood</td><td>Risk Rating</td><td>ALARP Tools</td><td>Acceptability</td><td>Outcome</td></tr>
<tr><td>Summary of source of risk/ impact</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Description of Source of Risk or Impact
Description of the identified risk/impact including sources or threats that may lead to the impact/risk or identified event. Regulation 13(1).
Impact or Consequence Assessment
Environmental Value/s Potentially Impacted
Discussion and assessment of the potential impacts to the identified environment value/s. Regulation 13(5) (6). Description of potential impacts to environmental values aligned to Woodside Risk Matrix consequence descriptors.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[7]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
ALARP/Hierarchy of Control Tools Used - Section 2.6.2				
Summary of control considered to ensure the impacts and risks are continuously reduced to ALARP. *Regulation 13(5)(c).*	*Technical/logistical feasibility of the control.* *Cost/sacrifice required to implement the control (qualitative measure).*	*Qualitative commentary of impact/risk that could be averted/ environmental benefit gained if the cost/ sacrifice is made and the control is adopted.*	*Proportionality of cost/sacrifice vs environmental benefit. If proportionate (benefits outweigh costs), the control will be adopted. If disproportionate (costs outweigh benefits), the control will not be adopted.*	*If control is adopted, reference to Control No. provided.*
Major Environment Events MEEs are subject to additional analysis and evaluation as outlined in Sections 2.7 and 6.8.2. ALARP is demonstrated through controls being analysed for selection, based on their independence, and prioritised in accordance with hierarchy of controls, and further analysed to consider the type of effect the control provides.				
ALARP Statement Made on the basis of the environmental risk/impact assessment outcomes, use of the relevant tools appropriate to the decision type (Section 2.8 and Figure 2-8) and a proportionality assessment. Regulation 10A (b).				

Demonstration of Acceptability
Acceptability Statement Made on the basis of applying the process described in Section 2.8 and Figure 2-8 taking into account internal and external expectations, risk/impact to environmental thresholds and use of environment decision principles. Regulation 10A(c)

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO No. **S**: *Specific performance that addresses the legislative and other controls that manage the activity, and against which performance*	**C No.** *Identified control adopted to ensure that the impacts and*	**PS No.** *Statement of the performance required of a control measure. Regulation 13(7)(a).*	**MC No.** *Measurement criteria for determining whether the outcomes and*

[7] Qualitative measure

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
by Woodside in protecting the environment will be measured. **M***: Performance against the outcome will be measured through implementation of the controls via the MC.* **A***: Achievability/feasibility of the outcome demonstrated via discussion of feasibility of controls in ALARP demonstration. Controls are directly linked to the outcome.* **R***: The outcome will be relevant to the source of risk/impact and the potentially impacted environmental value*[8] **T***: The outcome will state the timeframe during which the outcome will apply or by which it will be achieved.*	*risks are continuously reduced to ALARP.* *Regulation 13(5) (c).*		*standards have been met. Regulation 13(7)(c).*

6.5 Environment Risks/Impacts not Deemed Credible

The ENVID identified a source of environmental risk/impact that was assessed as not being applicable (not credible) within or outside the Operational Area and therefore was determined to not form part of this EP (refer Section 2.5). This is described in Section 6.5.1 for information only.

6.5.1 Shallow/Nearshore Activities

The Petroleum Activities Program is in water depths between ~75 m and 130 m, and at a distance of ~119 km from nearest landfall (Dampier). Consequently, risks/impacts associated with shallow/nearshore activities—such as anchoring and vessel grounding—were assessed as not credible.

[8] Where impact/consequence descriptors are capitalised and presented within EPOs in Section 6; performance level corresponds with those aligned with the Woodside Risk Matrix (refer Section 0).

6.6 Planned Activities (Routine and Non-routine)

6.6.1 Physical Presence: Disturbance to Marine Users

Context		
Location – Section 3.2 Operational Area – Section 3.3 Facility Layout and Description – Section 3.5 Facility Operations – Section 3.6.9	Socioeconomic and Cultural – Section 4.6	Stakeholder Consultation – Section 5

Impact Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Presence of Okha FPSO and subsea infrastructure excluding and/or displacing other users from PSZ and Operational Area respectively.	-	-	-	-	-	-	X	A	F	-	-	LCS GP PJ	Broadly Acceptable	EPO 1

Description of Source of Impact

The Okha FPSO commenced production in September 2011. Prior to this, the reservoirs were produced through the Cossack Pioneer FPSO, which commenced production in 1995. The Okha FPSO has been marked on nautical charts since that time. The FPSO lies within a PSZ that comprises the area within a 500 m radius of the RTM. The 500 m PSZ is shown as a 'Restricted Area' on navigation charts. The PSZ excludes vessels except those under the control of the operator or excepted as described in Notice to Mariners: A525517.

The physical footprint of subsea infrastructure is highly localised and entirely contained within the Operational Area. The AHS has been notified of the location of subsea infrastructure for marking on nautical charts. Water depths of subsea infrastructure range between ~75 m and 130 m.

Routine vessel activities associated with the Petroleum Activities Program are concentrated within the PSZ (e.g. support vessels at the FPSO). Subsea support vessels may undertake activities (e.g. IMMR activities) within the Operational Area at any time, including the Operational Area beyond the PSZ. The duration and location of these activities varies depending on the activity being undertaken. Vessels undertaking the Petroleum Activities Program meet maritime requirements, including appropriate lights and shapes, and communication with other vessels.

Impact Assessment

Exclusion and Displacement of Other Users

Commercial Fishing

Management boundaries for several Commonwealth and State fisheries were identified as overlapping the Operational Area (Section 4.6.3). The likely presence of commercial fishing vessels was assessed based on fishing gear type, historical effort and feedback from consultation, with consideration of the duration that the facility has been in operation (Section 3.4).

Commercial fishing vessels in the vicinity of the Operational Area are most likely to be participants of the Pilbara Demersal Scalefish Managed Fishery and Mackerel Managed Fishery and may use several gear types (including trawling). However, a portion of the Operational Area lies within Zone 2 Area 6 of the Pilbara Demersal Scalefish Managed Fishery, an area closed to trawling since 1997.

From 2013 to 2018, three vessels have fished intermittently in areas that may overlap the Operational Area. Historical data has identified that most of this fishing effort has been part of the Pilbara Demersal Scalefish Managed Fishery, as there has been no fishing effort from the Mackerel Managed Fishery since 2016 in the Operational Area. In 2018, the Operational Area overlapped 4.8% of the area used by the Pilbara Demersal Scalefish Managed Fishery. Consultation with fishing industry participants did not indicate any claims or objections from commercial fishers to the Petroleum Activities Program (Section 5).

The impact to commercial fishers as a result of the Petroleum Activities Program is considered to be a potential for highly localised displacement of effort with no lasting effect. As no trawling effort is expected to occur in the Operational Area, the potential for trawling gear to be snagged on subsea infrastructure is considered remote. No additional displacement or exclusion of commercial fisheries are expected in this revision of the EP.

Tourism and Recreation

Tourism and recreation activity in the Operational Area is expected to be infrequent. There are no emergent features or natural values within the Operational Area that are considered tourist attractions. Recreational and charter fishing from vessels are the only tourism and recreation activities identified that may potentially occur in the Operational Area. However, data indicates that there has been no catch effort from charter vessels in the Operational Area for the last five years (Section 4.6.5).

Given the distance from shore and boating facilities, lack of natural attractions and water depth of the Operational Area, no recreational or charter fishing has previously occurred or is expected to occur in the future. As such, impacts to recreational and charter fishing (entanglement of equipment, displacement of fishers) are expected to be localised with no lasting effect.

Shipping

Considerable commercial shipping occurs in the region (Section 4.6.6), comprising vessels such as:

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

To reduce the likelihood of interactions between commercial vessels and offshore facilities, AMSA has introduced a series of shipping fairways, within which commercial vessels are advised to navigate. The fairways are not mandatory, but AMSA strongly recommends commercial vessels remain within the fairway when transiting the region. The use of shipping fairways is considered to be good seafaring practice, with Australian Ship Reporting System data from AMSA indicating cargo ships and tankers routinely navigate within the established fairways. However, no recognised shipping lanes overlap the Operational Area; the nearest fairway lies ~35 km north-west of the Operational Area.

The presence of the Okha FPSO, associated subsea infrastructure and support vessels will not result in impacts to commercial shipping beyond a localised exclusion of shipping traffic from the PSZ, and the temporary displacement of commercial shipping from subsea support vessels as a result of vessels undertaking activities in the Operational Area. This is considered a localised impact, and of no lasting effect.

Oil and Gas

The nearest oil and gas platform is the NRC facility. NRC is operated by Woodside; impacts from the Petroleum Activities Program to NRC will not affect third parties. The nearest non–Woodside-operated production facility is the Reindeer platform operated by Santos, which is ~45 km south of the Operational Area (51 km from the Okha FPSO). Given the distance between the Operational Area and petroleum activities undertaken by other operators, no impacts to other operators will occur as a result of the presence of FPSO, vessels or subsea infrastructure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Order 21 (Safety and emergency arrangements) • Marine Order 30 (Prevention of Collisions). Compliance with Marine Orders 21 and 30 reduces the likelihood of interaction of vessel with the FPSO.	F: Yes CS: Minimal Cost. Standard practice.	Marine Orders 21 and 30 are required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class.	Control based on legislative requirement – must be adopted	Yes **C 1.1**
Implementation of a 500 m PSZ around the FPSO.	F: Yes CS: Minimal cost. Standard practice.	The PSZ is a requirement under the OPGGS Act.	Control based on legislative requirement – must be adopted.	Yes **C 1.2**
Good Practice				
Notifying AHS of location of permanent new Okha infrastructure to enable update of maritime charts, thereby reducing the likelihood of unplanned interactions with Okha infrastructure.	F: Yes: CS: Minimal cost. Standard practice	Notifying AHS will enable them to update maritime charts, thereby reducing the likelihood of unplanned interactions with Okha infrastructure.	Benefits outweigh the cost sacrifice	Yes **C 1.3**
Routinely consult stakeholders for the Petroleum Activities Program to ensure marine users are informed and aware, thereby reducing the likelihood of unplanned interactions with Okha infrastructure.	F: Yes: CS: Minimal cost. Standard practice	Routine consultation with marine users ensures they are informed and aware, thereby reducing the risk of unplanned interactions with Okha infrastructure	Benefits outweigh the cost sacrifice	Yes **C 1.4**
Professional Judgement – Eliminate				
Reduce the PSZ.	F: No. The PSZ is mandated by the OPGGS Act and is a safety and environment critical element; it cannot be reduced. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
None identified				

1 Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
Professional Judgement – Engineered Solution				
Over-trawl protection on subsea infrastructure.	F: Yes. Over-trawl protection on subsea infrastructure could be fitted to Okha FPSO subsea infrastructure. CS: Significant additional cost associated with designing and installing trawl protection on subsea infrastructure.	Over-trawl protection on subsea infrastructure could mitigate the potential for commercial fishing trawl gear to damage infrastructure or result in gear loss.	Given the Operational Area overlaps a small proportion of the fisheries management area open to trawl fishing, the cost of installing over-trawl protection is considered grossly disproportionate to the social benefit	No

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of the physical presence of the Okha FPSO, subsea infrastructure and vessels on other users. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, the ongoing physical presence of the Okha FPSO, subsea infrastructure and vessels represents a highly localised displacement to commercial fishing, shipping and other oil and gas titleholders with no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good practice and meet requirements of Marine Orders 21 and 30, and the expectations of WAFIC, AMSA and AHS provided during consultation with stakeholders. The potential impacts and risks are considered broadly acceptable, if the adopted controls continue to be implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of the physical presence of the Okha FPSO and support vessels to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 1 Prevent adverse interactions between vessels/FPSO and other marine users during the Petroleum Activities Program.	**C 1.1** Support vessels complying with Marine Orders for safe vessel operations: • Marine Order 21 (Safety of navigation and emergency procedures) • Marine Order 30 (Prevention of Collisions).	**PS 1.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class (Marine Orders 21 and 30).	**MC 1.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Orders 21 and 30).
	C 1.2 Implementation of a 500 m PSZ around FPSO.	**PS 1.2** PSZ monitored for incursions.	**MC 1.2.1** Records of adverse interactions in 500 m PSZ with other marine users entered into First Priority.
	C 1.3 Notifying AHS of locations of new permanent infrastructure to enable AHS to update maritime charts.	**PS 1.3** Woodside to notify AHS of location of new permanent infrastructure.	**MC 1.3.1** Records demonstrate that AHS has been notified of new permanent infrastructure.
	C 1.4 Undertaking consultation program to advise relevant persons of the Petroleum Activities Program and provide opportunity to raise objections or claims.	**PS 1.4** Implement a consultation process that conforms to the requirements of the Environment Regulations.	**MC 1.4.1** Records demonstrate a consultation program that conforms to the requirements of the Environment Regulations has been undertaken (refer to Section 7).

6.6.2 Physical Presence: Disturbance to Seabed

Context		
Location – Section 3.2 Operational Area – Section 3.3 Facility Layout and Description – Section 3.5 Facility Operations – Section 3.6.9	Socioeconomic and Cultural – Section 4.6	Stakeholder Consultation – Section 5

Impact Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Presence of subsea infrastructure (including moorings) modifying marine habitats.	-	X	X	-	X	-	-	A	F	-	-	LCS GP PJ	Broadly Acceptable	EPO 2
Subsea operations, inspection, maintenance and repair activities resulting in disturbance to seabed	-	X-	X-	-	X-	-	-	A	E	-	-			

Description of Source of Impact

Seabed disturbance associated with the Petroleum Activities Program can occur during operations and IMMR activities. Subsea infrastructure has been installed throughout the Operational Area (Section 3.3). Subsea equipment has been installed historically, subject to separate EPs. Installation and historical operations have described the benthic footprint/disturbance. The physical footprint of existing subsea infrastructure is described in this section for completeness.

The FPSO and subsea infrastructure also provides hard substrate habitat from the sea surface through the water column to the seabed (i.e. RTM), as well as along the seabed (e.g. flowlines, manifolds).

The presence of subsea infrastructure may result in localised scouring around the infrastructure due to currents, subsurface waves and seabed sediment fluid dynamics. Scour around subsea infrastructure is common in marine environments and may be addressed during IMMR campaigns.

Flowline movement may occur as per design and within integrity margins along flowline corridors.

To maintain the integrity of subsea infrastructure, routine subsea IMMR activities may be required, as described in Section 3.10. IMMR activities may impact the benthic environment near the activity. IMMR activities identified as impacting the benthic environment include (but are not limited to):

- inspections – minor, localised sediment resuspension by ROV
- marine growth removal – minor, localised resuspension of sediment; removal of marine biota from subsea infrastructure
- sediment relocation – minor, localised modification of benthic habitat and sediment resuspension
- span rectification, flowline protection and stabilisation – minor, localised modification of benthic habitat within the footprint of area subject to rectification/protection/stabilisation
- flowline, jumper and umbilical replacement – minor, localised modification of benthic habitat near the Flowline/ jumper/umbilical

- spool repair/replacement – minor, localised modification of benthic habitat near the spool.

The area of benthic habitat predicted to be impacted varies depending on the nature and scale of the IMMR activity.

Impact Assessment

The presence of subsea infrastructure and IMMR activities can be categorised into two potential impacts:

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

Water Quality

Indirect seabed disturbance may include localised and temporary decline in water quality due to increased suspended sediment concentrations and increased sediment deposition caused by IMMR activities and during disturbance to seabed from subsea infrastructure. However, sediment loads are not expected to be significant due to the relatively small footprint for each activity and event (described above, and in Section 3.10).

Benthic Communities/Habitats

The benthic habitat within the Operational Area is predominantly soft sediment with sparsely associated epifauna, which is broadly represented throughout the Northwest Province. Benthic communities of the soft sediment seabed are characterised by burrowing infauna such as polychaetes, with biota such as sessile filter feeders occurring on areas of hard substrate (such as subsea infrastructure).

IMMR activities such as span rectification, flowline protection and stabilisation will typically disturb a small area (typically <100 m^2) of soft sediment habitat. Scour and flowline movement may result in localised impacts to soft sediment habitats, typically on the scales of metres to tens of metres. Each discrete IMMR activity near the seabed is likely to cause a brief disturbance, which may result in suspended sediment. This sediment will subsequently be deposited down current as particles resettle. Such localised and short-term events may affect small areas of the seabed and consequently, impact the associated biota (typically sparsely distributed infauna and sessile epifauna). Given the expected nature and scale of resuspension resulting from these disturbances, impacts such as smothering or burial are not expected. Rather, impacts are likely to be restricted to increased ingestion of inedible sediments by filter feeders. Biota in the region are well adapted to periodic turbidity events caused by cyclones and tidal movements. As such, impacts from turbidity caused by these disturbances are not expected to have any lasting effect on benthic biota.

The estimated overall extent of such direct seabed disturbance is extremely small in relation to the extent of the soft sediment habitats, which are broadly represented within the Operational Area and the wider Northwest Province. Operational experience indicates disturbance to soft sediment habitats around subsea infrastructure associated with the Petroleum Activities Program is slight and short-term.

<u>Artificial Habitats</u>

Subsea infrastructure is often colonised by marine organisms; the availability of hard substrate is often a limiting factor in benthic communities. As such, the presence of infrastructure has led to the development of ecological communities that would not have existed otherwise (e.g. fouling communities on risers). For example, pipeline infrastructure has been shown to support demersal fish assemblages and benthic biota (e.g. sessile filter feeding communities) (McLean et al. 2017). IMMR activities may disturb these new communities; however, it is expected that recolonisation will occur.

The provision of artificial habitat associated with the Okha FPSO and subsea infrastructure will have either no adverse environmental impact or a low level of positive environmental impact through increasing biological diversity.

Values and Sensitivities

<u>Ancient Coastline at 125 m Depth Contour KEF</u>

The Operational Area overlaps ~30 km^2 of the 16,190 km^2 Ancient Coastline KEF, which is ~0.2% of the KEF. The Operational Area represents a buffer around the Okha subsea infrastructure to facilitate vessel operations; the potential for seabed disturbance is much more localised (i.e. within tens of metres of the subsea infrastructure).

Benthic habitat surveys in the region (including within the Ancient Coastline at 125 m Depth Contour KEF) indicate that benthic habitats within the KEF are characterised by sand interspersed with areas of rubble and outcroppings of limestone pavement (AIMS 2014b, RPS 2011). Such habitats are widely distributed in the NWMR. No significant escarpments, species of conservation significance, emergent features or areas of high biological productivity characteristically associated with the Ancient Coastline KEF have been observed in the Operational Area. As noted in Section 4.7.5.1 the geomorphic feature the KEF is associated with is represented worldwide and represents the coastline during a previous glacial period. Therefore, potential impacts to this regional-scale KEF are expected to be localised with no lasting effect.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[10]***	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
None identified.				
Good Practice				
None identified.				
Professional Judgement – Eliminate				
Vessels used for IMMR activities are DP-capable – use of DP instead of anchoring reduces potential impacts to benthic habitats	F: Yes CS: Minimal. Subsea support vessels undertaking IMMR activities routinely use DP to hold station	By using DP, the potential impacts to benthic habitats are reduced	Benefits outweigh the cost sacrifice	Yes **C 2.1**
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; ROVs are an integral part of IMMR activities. CS: Not assessed, control not feasible	Not assessed, control not feasible	Not assessed, control not feasible	No
Professional Judgement – Substitute				
None identified				
Professional Judgement – Engineered Solution				
Monitoring of seabed surrounding subsea infrastructure.	F: Yes. ROV footage collected as part of subsea integrity surveys could be reviewed to observe and detect changes in benthic habitats. CS: Costs associated with reviewing collected footage	Limited environmental benefit (information) gained from monitoring benthic habitats.	Given the low sensitivity of the environment surrounding associated subsea infrastructure, any environmental benefit gained is outweighed by costs associated with implementing the control.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls including regular maintenance and inspection activities appropriate to manage the impacts of seabed disturbance from planned activities. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				
Demonstration of Acceptability				
Acceptability Statement The impact assessment has determined that, given the adopted controls, seabed disturbance from operations and subsea activities is unlikely to result in an impact greater than a slight and short-term impact to benthic habitats, sediment and water quality. Further opportunities to reduce the impacts have been investigated above. The adopted controls are considered good oilfield practice/industry best practice. The potential impacts are considered broadly				

10 Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[10]***	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of operations and subsea activities to a level that is broadly acceptable.				

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 Limit impacts to benthic habitats to Slight (E) beyond the physical footprint of the facility infrastructure during the Petroleum Activities Program.	**C 2.1** Vessels used for IMMR activities will be DP-capable.	**PS 2.1** Use of DP by IMMR activity vessels (no anchoring required) unless in an emergency or Woodside authorisation is provided.	**MC 2.1.1** Records demonstrate that subsea support vessels are equipped with DP system.

6.6.3 Routine Acoustic Emissions: Generation of Noise during Routine Operations

Context	
Facility Layout and Description – Section 3.5 Operational Details – Section 3.6 Facility Operations – Section 3.6.9 Subsea Inspection, Maintenance and Repair Activities – Section 3.10	Species – Section 4.5.2

Impact Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Noise generated within the Operational Area from: • vessels and IMMR activities • helicopters • Okha FPSO and associated infrastructure.	-	-	-	-	-	X	-	A	F	-	-	LCS GP PJ	Broadly Acceptable	EPO 3

Description of Source of Impact

The FPSO, vessels, IMMR equipment and helicopters generate noise both in the air and underwater due to the operation of machinery, propeller movement, etc. Typical noise levels for these sources are provided in Table 6-3 and Table 6-4 with more detailed descriptions below. This noise contributes to and can exceed ambient noise levels, that range from around 90 dB re 1 µPa sound pressure level (SPL) under very calm, low wind conditions, to 120 dB re 1 µPa SPL under windy conditions (McCauley 2005).

Table 6-3: Indicative source characteristics of continuous underwater noise associated with the Petroleum Activities Program

Acoustic Noise Sources	Estimated SPL (dB re 1 µPa SPL) @1 m unless otherwise stated	Frequency Range (kHz)
Vessels (Continuous)		
FPSO*	181	Broadband
Support vessel using DP‡	187	Broadband
Wellhead, Flowlines and Subsea Infrastructure (Continuous)		
Wellhead§	113	Broadband
Choke valve§	155	Broadband

** Range provided was not measured at the noise source; therefore, this should be used as an indicative estimate only and cannot be used to estimate exposure thresholds closer to the source.*

§ McCauley (2002)

‡ McCauley (2005)

Vessels

Vessels may emit noise through the hull acting as a transducer (e.g. machinery vibration being converted to underwater noise), as well as through cavitation from fast-moving surfaces such as propellers and thrusters. The main source of noise from vessels (both FPSO support and subsea support vessels) relates to the use of DP thrusters (i.e.

cavitation from thruster propellers). The vessels undertaking the Petroleum Activities Program are expected to spend time holding station during DP, which requires the use of thruster. Thruster noise (from cavitation caused by propellers) is typically the most significant noise source for vessels holding station, with other noise sources typically relatively minor (McCauley 1998).

Thruster noise is typically high intensity and broadband in nature. McCauley (1998) measured underwater broadband noise up to ~182 dB re 1 µPa at 1 m root mean square sound pressure level (rms SPL) from a support vessel holding station in the Timor Sea. It is expected that noise levels up to this this level may be generated by vessels using DP during the Petroleum Activities Program

All support vessels are required to comply with EPBC Regulation 2000 – Part 8 Interacting with Cetaceans to reduce the likelihood of collisions with cetaceans (refer to Section 6.7.3). Implementing this control may incidentally reduce the noise generated by vessels close to cetaceans as vessels are travelling slower; slower vessel speeds may reduce underwater noise from machinery noise (main engines) and propeller cavitation.

Helicopters

Helicopter engines and rotor blades are recognised as a source of noise emissions, which may constitute a source of environmental risk resulting in behavioural disturbance to marine fauna. Activities relevant to the Operational Area relate to helicopter take-off and landing on the FPSO (typically every two days) and potentially subsea support vessels. During these critical stages of helicopter operations, safety takes precedence. Helicopter flights are at their lowest (i.e. closest point to the sea surface) during these periods of take-off and landing from heli-decks, which constitutes a short phase of routine flight operations.

Wellhead, Flowlines and Subsea Infrastructure

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

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

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

FPSO Machinery

The FPSO may use its main engines when manoeuvring on, or disconnected from, the RTM, generating underwater noise from hull vibrations and propeller cavitation. These activities are typically of short duration. Machinery such as topsides processing equipment may generate noise emissions. Noise emitted by topsides equipment is considered unlikely to contribute significantly to underwater noise levels. However, topsides equipment and other machinery may contribute to hull vibrations, which may then be transmitted through the hull. Such noise is typically constant during routine operations.

Measurement of underwater sound taken at the Cossack Pioneer FPSO during 2002 during normal operations recorded broadband source levels up to 181 dB re 1 µPa. This included measurements when its propeller was in use (slowly turning) (McCauley 2002b). Source levels at the Cossack Pioneer were comparable to those recorded at Ngujima Yin FPSO during normal operations, which recorded average broadband source levels of 174 dB re 1 µPa under calm conditions (JASCO 2010). The higher source level recorded at Cossack Pioneer is considered representative of the source level at Okha FPSO at intermittent times when there is a requirement to use its main engine and propeller.

The HP and LP flare system generates noise from combustion. Noise from flaring represents a health and safety risk to personnel and was considered in the design of the Okha FPSO to manage the associated occupational health and safety risks (e.g. height specification of flare tower). Noise from flaring is emitted at the top of the flare tower, ~82 m above the main deck. Noise from the tip of the flare is not constrained and spreads spherically in all directions.

Subsea IMMR Activities

Subsea IMMR activities may result in localised, temporary increased in underwater noise. Sources proposed (Table 6-4) have frequency outputs ranging from 2 kHz (SBP Chirp) to 900 kHz (SSS).

High-frequency acoustic signals attenuate more rapidly underwater compared to lower frequencies. Given the operating frequency of the MBES and SSS, underwater noise generated from this equipment is expected to attenuate rapidly in the water column. The position of the acoustic source in the water column influences the horizontal transmission of noise. Sources towed close to the seabed, typically via an autonomous underwater vehicle have a smaller distance between the source and the seabed, reducing received levels in the horizontal direction due to seafloor scattering and absorption. Therefore, received noise levels at defined horizontal distances from the system are lower compared a surface-towed source. Given the nature and scale of expected IMMR activities, noise generated during these activities is expected to be similar to, or less than, noise generated by subsea infrastructure during routine operations.

Table 6-4: Frequency ranges of IMMR sources and marine fauna

IMMR source	Frequency Range (kHz) (Jimenez-Arranz et al. 2017)	Estimated range of Source Level (dB re 1 µPa SPL @1 m	Potential disturbance from acoustic source						
			Low-frequency cetaceans[1]	*Mid-frequency cetaceans[1]*	*High frequency cetaceans[1]*	*Marine turtles[3]*	*Whale sharks[2]*	*Fish – hearing specialists[4]*	*Fish – hearing generalists[4]*
Auditory frequency range (kHz)			***0.07 – 22***	***0.15 – 160***	***0.2 – 180***	***0.1–0.7***	***0.02–0.8***	***0.1–3***	***0.2–0.8***
MBES	12–700 (deep) 150–700 (shallow)	210–247	Deep only	✓	✓				
SSS	75–900	200–234		✓	✓				
SBP – Chirp	2–23	167–212	✓	✓	✓			✓	
SBP – Pinger	2–20	161–205	✓	✓	✓			✓	
Ultra-short baseline (USBL) / Acoustic Array	18–36	187–196	✓	✓	✓				

1 Southall et al. 2007

2 The estimated auditory bandwidth of whale sharks is unknown, a range of 0.02–0.8 kHz has been applied, which is the known approximate sensitivity of among sharks as outlined in Myrberg 2001. Although there are no known studies on whale shark auditory hearing bandwidths, research suggests the large hearing structures of the whale shark would be most responsive to long wavelength, low-frequency sound (Myrberg, 2001).

3 The estimated auditory bandwidth of turtles is 0.1–0.7 kHz as determined by electro-physical studies (McCauley 1994)

4 Effects of seismic airguns and other sources of pulsed sound on marine fishes (URS 2007).

Impact Assessment

The Operational Area is in waters ~75 m to 130 m deep on the continental shelf. The fauna associated with this area will be predominantly pelagic species of fish, with migratory species such as turtles, birds, whale sharks and cetaceans present in the area seasonally. Two EPBC Act listed species have BIAs that overlap the Operational Area; these are discussed below.

The Ancient Coastline at 125 m Depth Contour KEF also overlaps the Operational Area. Fauna associated with the KEF, such as demersal fish, may also be impacted upon by noise emissions. Although the Ancient Coastline KEF may be associated with outcroppings of hard substrate, no evidence of significant reefs associated with such outcroppings has been found in the Operational Area. Note: Some demersal fish are also likely to be associated with subsea infrastructure such as the WC GEL (McLean et al. 2017).

Cetaceans

The potential impacts of anthropogenic noise on marine mammals have been the subject of considerable research; reviews are provided by Richardson et al. (1995), Nowacek et al. (2007), Southall et al. (2007), Weilgart (2007) and Wright et al. (2007).

Southall et al. (2007), Finneran and Jenkins (2012) Wood et al. (2012), and more recently the US National Marine Fisheries Service (NMFS 2018) reviewed available literature to determine exposure criterion for temporary hearing threshold shift (TTS) and injury, referred to as the onset of non-recoverable permanent hearing loss (permanent threshold shift [PTS]). In addition, behavioural thresholds were taken from the NMFS. These thresholds are outlined in

Table 6-5 and are considered appropriate for the assessment of impacts from acoustic discharges to cetaceans from the Petroleum Activities Program.

Table 6-5: Impulsive noise exposure thresholds at which physiological and behavioural impacts to cetaceans may occur

Reference	Impact Type	Minimum Threshold	
		SPL	***Sound exposure level (SEL)***
Southall et al. 2007	PTS (All Cetaceans)	230 dB re 1 µPa (peak)	198 dB re 1 µPa^2.s (m-weighted)
	TTS (Low Frequency Cetaceans)	224 dB re 1 µPa (peak)	192 dB re 1 µPa^2.s (m-weighted)
National Marine Fisheries Service (NMFS) 2014 and Southall et al. 2007	Behavioural Response Adults (Cetaceans)	160 dB re 1 µPa (rms)	-

To inform the assessment, the continuous source impact thresholds provided in Table 6-6 were considered in relation to the credible sources of acoustic emissions.

Table 6-6: Continuous sources – impact thresholds for environmental receptors

Receptor	Mortality and potential mortal injury	PTS	TTS	Behaviour
Low-frequency cetaceans*	n/a	198 dB re 1 µPa^{2}s M-weighted SEL	183 dB re 1 µPa^{2}s M-weighted SEL	120 dB re 1 µPa rms SPL
Mid-frequency cetaceans*	n/a	198 dB re 1 µPa^{2}s M-weighted SEL	183 dB re 1 µPa^{2}s M-weighted SEL	120 dB re 1 µPa rms SPL
High-frequency cetaceans*	n/a	198 dB re 1 µPa^{2}s M-weighted SEL	183 dB re 1 µPa^{2}s M-weighted SEL	120 dB re 1 µPa rms SPL

Note: A range of sound units are provided in the table above, reflecting the range of studies from which this data has been derived. The difference in units presents difficulty in reliably comparing threshold values. Where practicable, the threshold values have been compared with indicative sound sources levels of the same sound unit types to facilitate comparison. The sound units provided in the table above include M-weighted sound exposure level (SEL): a weighted sound metric that emphasises the audible frequency bands for the receptor groups – low, mid- and high frequency cetaceans. SEL units are time integrated and best suited for continuous noise sources, such as vessels holding station or continuous machinery noise.

Source: Based on based on Southall et al. (2007) and NMFS (2005)

Marine Turtles

Because of their rigid external anatomy, it is possible that sea turtles are highly protected from impulsive sound effects (Popper et al. 2014). However, McCauley et al. (2003), Popper et al. (2014) and O'Hara and Wilcox (1990) reference behavioural exposure thresholds for impulsive noise sources on caged green and loggerhead turtles and turtle injury thresholds (Table 6-7).

Moein et al. (1994) tested if hearing sensitivity of caged loggerhead turtles altered after being exposed to several hundred pulses within 30 to 65 m of a single airgun (pulse numbers and received sound levels not stated). Hearing was tested before, within a day, and then two weeks after exposure. About 50% of the exposed individuals indicated altered hearing sensitivity when tested within a day of their exposure, but compared to the pre-exposure tests, none provided any sign of altered hearing two weeks later. These results align with the thresholds provided in Table 6-7 that suggest the risk of PTS is low, even when close to the acoustic source. The thresholds listed in Table 6-7 and Table 6-8 are considered appropriate for the assessment of impacts from acoustic discharges to cetaceans from the Petroleum Activities Program.

Table 6-7: Impulsive noise exposure thresholds for injury and behaviour response for marine turtles

Species	Received Level			Effect	Source
	(dB re 1 µPa RMS)	*(dB re 1 µPa pk)*	*(cSEL (dB re 1 µPa.s²)*		
Sea turtles	-	>207	210	Injury	Popper et al. (2014)
Loggerhead turtle	175–176	-	-	Avoidance response	O'Hara and Wilcox (1990)
One green and one loggerhead turtle	166	-	-	Noticeable increase in swimming behaviour, presumed avoidance response	McCauley et al. (2003)
One green and one loggerhead turtle	175	-	-	Behaviour becomes increasingly erratic, presumed alarm response	McCauley et al. (2003)

Table 6-8: Continuous sources – turtle impact threshold for environmental receptors

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

Note: A range of sound units are provided in the table above, reflecting the range of studies from which this data has been derived. The difference in units presents difficulty in reliably comparing threshold values. Where practicable, the threshold values have been compared with indicative sound sources levels of the same sound unit types to facilitate comparison. The sound units provided in the table above include: relative risk (high, medium and low) is given for fish (all types), turtles and eggs and larvae at three distances from the source defined in relative terms as near (N), intermediate (I) and far (F) (after Popper et al. 2014).

† Popper et al. (2014)

Fish

Fish perceive sound through the ears and the lateral line, which are sensitive to vibration. Some species of teleost or bony fish (e.g. herring) have a structure linking the gas-filled swim bladder and ear, and these species usually have increased hearing sensitivity. These species are considered to be more sensitive to anthropogenic underwater noise sources than species such as cod (*Gadus* sp.), which do not possess a structure linking the swim bladder and inner ear. Fish species that either do not have a swim bladder (e.g. elasmobranchs and scombrid fish [mackerel and tunas]) or have a much-reduced swim bladder (e.g. flat fish) tend to have a relatively low auditory sensitivity. Considering these differences in fish physiology, Popper et al. (2014) developed sound exposure guidelines for fish; these are presented in Table 6-9 and Table 6-10 and are considered appropriate to assess potential impacts of acoustic discharges to fish.

Table 6-9: Impulsive noise exposure thresholds for different types of fish

Type of Fish	Recoverable Injury (PTS)	Temporary Threshold Shift (TTS)	Behaviour*
Type 1 – no swim bladder (particle motion detection)	>216 dB re 1µPa²s (cSEL) or >213 dB re 1µPa (SPL peak)	>>186 dB re 1µPa²s (cSEL)	(N) High (I) Moderate (F) Low
Type 2 – Swim bladder is not involved in hearing (particle motion detection)	>207 dB re 1µPa²s (cSEL) or >203 dB re 1µPa (SPL peak)	>186 dB re 1µPa²s (cSEL)	(N) High (I) Moderate (F) Low
Type 3 – Swim bladder involved in hearing (primarily pressure detection)	207 dB re 1µPa²s (cSEL) or >203 dB re 1µPa (SPL peak)	186 dB re 1µPa²s (cSEL)	(N) High (I) High (F) Low

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

Source: Popper et al. (2014)

Table 6-10: Continuous sources – fish and turtle impact threshold for environmental receptors

Receptor	Mortality and potential mortal injury	PTS	TTS	Masking	Behaviour
Fish: no swim bladder†	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder not involved in hearing†	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder involved in hearing†	(N) Low (I) Low (F) Low	170 dB rms SPL for 48 hours	158 dB rms SPL for 12 hours	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Sea turtles†	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low

Note: A range of sound units are provided in the table above, reflecting the range of studies from which this data has been derived. The difference in units presents difficulty in reliably comparing threshold values. Where practicable, the threshold values have been compared with indicative sound sources levels of the same sound unit types to facilitate comparison. The sound units provided in the table above include:

- *Root mean square (rms) sound pressure level (SPL): root mean square of time-series pressure level, useful for quantifying continuous noise sources (as per SEL point above).*
- *Relative risk (high, medium and low) is given for fish (all types), turtles and eggs and larvae at three distances from the source defined in relative terms as near (N), intermediate (I) and far (F) (after Popper et al. 2014).*

Source: Popper et al. (2014)

Vessel Noise

Vessels holding station are considered to be the predominant noise source related to the Petroleum Activities Program. Using the thruster noise measured by Quijano and Mcpherson (2018) as an indicative value for the potential thruster noise generated by vessels during the Petroleum Activities Program and the thresholds presented in Table 6-6, the potential for noise-induced mortality or injury of cetaceans, fish, sea turtles and eggs/larvae is not considered credible. However, other impacts such as masking and behavioural impacts may occur. Modelling of vessel DP sound propagation was undertaken using dBSEA parabolic equation solver and DP vessel worst-case (rough) thruster noise of 187 dB re 1 µPa.

Potential impacts may include:

- Cetaceans: Potential behavioural disturbance out to ~5–7 km for cetaceans, likelihood of PTS or TTS is considered not to be credible, given individuals would need to be directly next to the noise source for prolonged duration and vessels are not point sources (i.e. sound is distributed from multiple locations of the vessel over a large area).
- Fish: Potential masking and behavioural disturbance at near and intermediate range; likelihood of PTS or TTS is considered not to be credible given fish would move away from the source. Site-attached fish (e.g. demersal fish) are not expected to be exposed to underwater noise above impact thresholds given water depths in the area where these fish may be more prevalent (i.e. the Ancient Coastline KEF).
- Turtles: Potential masking and behavioural disturbance at intermediate and far range, likelihood of PTS or TTS is considered not to be credible given turtles would need to be directly next to the noise source.

These estimated propagation ranges are considered to underestimate TL, and are, hence, inherently conservative, due to use of high-intensity thruster noise (i.e. thruster operating at full power in rough weather); most time thruster use is at lower than full power, with a concomitant reduction in cavitation noise intensity.

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

IMMR Activities

JASCO (2013) conducted noise modelling for five low-energy survey instruments off the coast of California. Three of these instrument types are comparable to those outlined in Section 3—MBES, SSS, SBP (Chirp). All equipment types were modelled in the sandy bottom environment, similar to that of the Operational Area, and in 64 m water depth. Although the bathymetry, salinity, water temperature and sub seafloor sediment type may differ, given the similarities in equipment type, seafloor habitat and water depth, the modelling is considered comparable for the nature and scale of the low energy IMMR survey equipment.

The modelling reported distances to specific threshold levels for different types of marine mammals. Where applicable m-weighted R_{max} (the distance to the farthest occurrence of the threshold level) estimates were used. Since receptors identified in Section 4 include a greater range of species, unweighted R_{max}, was used for species where m-weighted estimates were not appropriate, which is considered conservative. The distances at which the 160 dB re 1 µPa (rms SPL) behavioural threshold was reached (R_{max}) are:

- MBES – 290 m
- SSS – 682 m
- SBP (Chirp) – 36 m
- acoustic transponder – 50 m.

The equipment listed in Table 6-3, which were not modelled in the JASCO study (2013), include the SBP (pinger) and USBL. The SBP (pinger) equipment operates at similar frequencies and pressure to the SBP (Chirp) and behavioural impact ranges are estimated to be similar.

Table 6-11: Summary of impact thresholds and R_{max} for different species

Species	Effect	Threshold (impulsive noise)		R_{max} (metres)				
		SPL	*SEL*	*MBES**	*SSS**	*SBP (Chirp)**	*SBP (Pinger)†*	*USBL†*
Cetaceans	PTS (all cetaceans)[1]	230 dB re 1 µPa (peak)	198 dB re 1 µPa^2.s (m-weighted)	N/A	N/A	N/A	N/A	N/A
	TTS (low-frequency cetaceans)[1]	224 dB re 1 µPa (peak)	192 dB re 1 µPa^2.s (m-weighted)	N/A	N/A	N/A	N/A	N/A
	Behavioural Response Adults (cetaceans)[1,2]	160 dB re 1 µPa (rms)	-	290	<693	<36	<50	<50
Marine turtles	Injury[3]	> 207 dB re 1 µPa (peak)	210 dB re 1 µPa^2.s	N/A	N/A	N/A	N/A	N/A
	Avoidance response[4]	175–176 dB re 1 µPa (rms)	-	N/A	N/A	<20	N/A	N/A
	Noticeable increase in swimming behaviour, presumed avoidance response[5]	166 dB re 1 µPa (rms)	-	N/A	N/A	<36	N/A	N/A
	Behaviour becomes increasingly erratic, presumed alarm response[5]	175 dB re 1 µPa (rms)	-	N/A	N/A	<20	N/A	N/A
Fish – Type 1	PTS[3]	>213 dB re 1 µPa (SPL peak)	>216 dB re 1 µPa^2.s	N/A	N/A	<1	N/A	N/A
	TTS[3]	-	>>186 dB re 1 µPa^2.s	<20	N/A	<20	N/A	N/A

Fish – Type 2	PTS[3]	>203 dB re 1 µPa (SPL peak)	>207 dB re 1 µPa².s	N/A	N/A	<5	N/A	N/A
	TTS[3]	-	>186 dB re 1 µPa².s	<20	N/A	<50	N/A	N/A
Fish – Type 3	PTS[3]	>203 dB re 1 µPa (SPL peak)	207 dB re 1 µPa².s	N/A	N/A	<20	N/A	N/A
	TTS[3]	-	186 dB re 1 µPa².s	<20	<20	<50	N/A	N/A

Notes:

N/A stated where operating frequency is outside species auditable hearing range or where exceeding threshold is not credible

** R_{max} provided as presented in JASCO (2013)*

† R_{max} provided based on spreading calculations

1 Southall et al. (2007)

2 NMFS (2013)

3 Popper et al. (2014)

4 O'Hara and Wilcox (1990)

5 McCauley et al. (2003)

Helicopter Noise

Water has a very high acoustic impedance contrast compared to air, and the sea surface is a strong reflector of noise energy (i.e. very little noise energy generated above the sea surface crosses into and propagates below the sea surface (and vice versa) – most noise energy is reflected). The angle at which the sound path meets the surface influences the transmission of noise energy from the atmosphere through the sea surface, angles >13° from vertical being almost entirely reflected (Richardson et al. 1995). Given this, and the typical characteristics of helicopter flights within the Operational Area (duration, frequency, altitude and air speed), the opportunity for underwater noise levels that may result in behavioural disturbance to marine fauna are not considered credible.

Wellheads, Flowlines and Okha FPSO Machinery Noise

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

Flare noise, like helicopter noise, is generated in the atmosphere and has limited potential to propagate in the sea due to the high acoustic impedance of water. Additionally, the height of the flare tower and the unconstrained propagation of noise from the flare in the atmosphere means the potential for impacts to fauna at or near the sea surface is inherently highly unlikely. Receptors above the water, such as birds, may be exposed to noise from the flare. Operational experience indicates birds routinely roost at a range of locations on the Okha FPSO and do not experience any discernible behavioural disturbance due to noise from the flare. As such, impacts to sensitive receptors from flare noise will have no lasting effect and will be highly localised.

Summary

Cetaceans

There is the potential for cetaceans to be exposed to underwater noise from vessels associated with the Petroleum Activities Program. However, as the peak underwater noise levels that may be generated by vessels and IMMR activities are below those resulting in injury or mortality, only behavioural impacts are credible out to 5–7 km from a DP vessel and up to 700 m from IMMR activities; any other potential impacts are considered negligible. Impacts are expected to be limited to localised avoidance of the noise source as there are no physical barriers in or near the Operational Area that may prevent cetaceans from moving away from vessels.

Fishes

Fish may temporarily be displaced from the immediate vicinity of a noise source; however, they would be expected to behave normally once the noise emissions ceased. A foraging BIA for whale sharks overlaps the Operational Area, and the species may be seasonally present (particularly between March and July) during their annual migration to and from the aggregation area off Ningaloo Reef. Whale sharks are not considered to be particularly vulnerable to underwater noise, and they do not have a swim bladder (considered to increase the vulnerability of a fish to noise-related impacts). Potential impacts to whale sharks from continuous noise (e.g. vessel noise) are expected to be no more than a short-term temporary displacement from noise sources while transiting the Operational Area. The IMMR activities noise sources are all higher in frequency (>2 kHz); therefore, they are mostly outside the range of fish hearing (2–4 kHz)

Demersal and pelagic fish species will be present in the Operational Area, including fish communities associated with the Ancient Coastline at 125 m Depth Contour KEF. Impacts to fish are expected to be localised, of short duration, and restricted to behavioural responses such as avoidance of noise sources. Turtles Noise interference is listed as a key threat to threatened marine turtles identified as potentially occurring within the Operational Area (Table 4-4). Turtles may occur in the Operational Area although the area does not contain any known significant foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals/banks). A flatback turtle internesting buffer BIA overlaps the Operational Area. However, the BIA only overlaps the Goodwyn-6 suspended exploration well section of the Operational Area and is ~18 km from the location of the Okha FPSO. Turtles may exhibit behavioural responses such as diving when exposed to underwater noise (e.g. vessel noise). IMMR-related noise is not expected to result in behavioural response, injury or mortality of individuals, or any other lasting effect, as the source frequency of proposed equipment (2–900 kHz) is well outside the known hearing frequency range of turtles (0.1–0.7 kHz).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[11]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Maintain helicopter separation from cetaceans as per EPBC Regulations 2000 Part 8 Division 8.3 (Regulation 8.07), which include the following measures: • Helicopters shall not operate lower than 1,650 feet or within a horizontal radius of 500 m of a cetacean known to be present in the area, except for take-off and landing.	F: Yes CS: Minimal cost. Standard practice.	Reduces likelihood of disturbance to cetaceans by maintaining separation distance.	Controls based on legislative requirements – must be adopted.	Yes **C 3.1**
Good Practice				
Implementing a shutdown zone around MBES, SSS and SBP for these fauna: • whales • marine turtles • whale sharks.	F: Yes. However, as equipment is underwater, effective implementation of zones is challenging from topsides observation. CS: Moderate. Requires the provision of a dedicated suitably trained crew member to undertake marine fauna observations.	Limited. The areas of disturbance for these devices are limited to within ~700 m of the source. Note: The frequency range of MBES and SSS are outside the estimated frequency hearing range of identified protected species (whales, turtles and whale sharks).	The source levels and frequency range of these devices are outside the estimated frequency hearing range of identified protected species (whales, turtles and whale sharks), so costs are considered disproportionate to benefits.	No
Professional Judgement – Eliminate				
Eliminating the use of DP on vessels during the	F: No. Both FPSO and subsea support vessels are required to reliably hold	Not considered, control not feasible.	Not considered, control not feasible.	No

[11] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[11]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Petroleum Activities Program.	station during the Petroleum Activities Program. Failure to do so may lead to loss of separation between vessels and infrastructure. This would result in unacceptable safety and environmental risk (loss of marine vessel separation has been identified as a MEE –07 Section 6.8.9). CS: Not considered, control not feasible.			
Restricting IMMR activities to outside ecologically sensitive periods for cetaceans and turtles	F: Yes. IMMR activities can be rescheduled; however, they may be required within ecologically sensitive periods for turtles and cetaceans to ensure equipment integrity and to reduce potential environmental and safety risks. CS. Moderate, costs associated with rescheduling activity.	Limited IMMR activities emit low-frequency sounds and are short and temporary in nature.	The source levels and frequency range of IMMR activities are outside the estimated frequency hearing range of identified protected species (cetaceans and turtles), so costs are considered disproportionate to benefits.	No
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
None identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the continued impacts from routine acoustic emissions from vessels, helicopters, wellheads, flowline and the Okha FPSO (including machinery) to be ALARP in their current impact classification. As no reasonable additional/ alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, in its current state, impacts from routine acoustic emissions from vessels, helicopters, wellheads, flowline and the Okha FPSO (including machinery) represent a localised impact to marine fauna behaviour around and within the Operational Area, with no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The impacts are consistent with good oilfield practice/industry best practice and are considered broadly acceptable in their current state. Therefore, Woodside considers standard operations appropriate to manage the impacts of acoustic emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 3 Limit impacts on fauna from noise emissions during the Petroleum Activities Program.	**C 3.1** Maintaining helicopter separation from cetaceans as per EPBC Regulations 2000 Part 8 Division 8.3 (Regulation 8.07), which includes this measure: • Helicopters shall not operate lower than 1,650 feet or within a horizontal radius of 500 m of a cetacean known to be present in the area, except for take-off and landing.	**PS 3.1** Interactions between helicopters and cetaceans will be consistent with EPBC Regulations 2000 Part 8 Division 8.3 (Regulation 8.07) Interacting with cetaceans.	**MC 3.1.1** Records demonstrate no breaches with EPBC Regulations 2000 Part 8 Division 8.3 (Regulation 8.07) Interacting with cetaceans.

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

Context	
Wells and Reservoirs – Section 3.5.2 Hydrocarbon and Chemical Inventories and Selection – Section 3.9 Subsea Inspection, Maintenance and Repair Activities – Section 3.10	Physical Environment – Section 4.4 Biological Environment – Section 4.5

Impact Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Discharge of subsea control fluids.	-	X	X	-	X	-	-	A	E	-	-	LCS GP PJ	Broadly Acceptable	EPO 4
Discharge of hydrocarbons remaining in subsea pipework and equipment during subsea intervention works (including pigging).	-	X	X	-	X	-	-	A	E	-	-			
Discharge of chemicals remaining in subsea pipework and equipment, or the use of chemicals for subsea IMMR activities.	-	X	X	-	X	-	-	A	F	-	-			
Discharge of minor fugitive hydrocarbons from wells and subsea equipment.	-	-	X	-	-	-	-	A	F	-				

Description of Source of Impact

Hydrocarbons and chemicals may be discharged because of planned routine and non-routine activities, including:

- operational discharges:
  - discharge of subsea control fluids – subsea control fluid is used to control valves remotely from the facility. It is an open-loop system, designed to release control fluid from the control system during valve operations (e.g. <6 L upon typical valve actuation)
  - potential non-routine hydraulic fluid discharge associated with umbilical system losses/weeps
  - discharge of minor fugitive hydrocarbon from wells and subsea equipment (e.g. weeps/seeps/bubbles)
  - discharge of chemicals introduced into subsea infrastructure and the production stream, either as process or non-process chemicals (e.g. corrosion inhibitors, biocides, scale inhibitors). Chemicals flow through the production process, with residual chemicals discharged as a component of the PW discharged overboard
- IMMR activities (nominal discharges described in Section 3.10.1.6):
  - discharge of residual hydrocarbons in subsea lines and equipment and small gas releases associated with isolation testing and breaking containment

- discharge of residual chemicals in subsea lines and equipment, or the use of chemicals. These chemicals are used and discharged intermittently in small volumes. Small quantities of chemicals may remain in the flushed infrastructure, which may be released to the environment after disconnection.

Note: Subsea preservation and hydrotest fluids may be discharged subsea or after handling onboard the FPSO. Unplanned discharges of hydrocarbons and chemicals are considered in Section 6.7.1.

Impact Assessment

As a result of planned routine and non-routine hydrocarbon, subsea control fluid and chemical discharges, there is potential for slight, short-term localised decrease in water and sediment quality at discharge locations and ecosystem impacts. Subsea control fluid discharge locations are either at the SCMs or via the Okha FPSO.

Water Quality

Subsea control fluids are discharged in relatively small volumes from SCM vent ports during valve operations at or near the seabed. Once released into a low-sensitivity receiving environment, subsea control fluids are expected to mix rapidly and dilute in the water column. Hydrocarbons, which may be released during operational and IMMR activities (including pigging) that break containment of isolated subsea infrastructure, are buoyant and will float towards the surface. Given the water depth, pressure, and the small volumes released, these hydrocarbons are not expected to reach the sea surface. Rather, the release will disperse and/or dissolve within the water column. Chemicals may be discharged intermittently and in small volumes.

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

Sediment Quality

Accumulation of contaminants in sediments depends primarily on the volume/concentration of particulates in discharges or constituents that adsorb onto seawater particulates, the area over which those particulates could settle onto the seabed (dominated by current speeds and water depths), and the resuspension, bioturbation and microbial decay of those particulates in the water column and on the seabed. Some components of subsea control fluid are slower to biodegrade—these components make up ~0.35% of the total volume. Valve actuation discharges are frequent but low in volume (typically <6 L). The toxic component of a typically subsea control fluid release is <39 ml. Up to18 ml is readily biodegradable. The remaining 21 ml does not bioaccumulate but may be present in the sediments in the immediate vicinity of the discharge location. Given the frequency and volumes of hydrocarbon releases, accumulation in sediments is not considered likely.

Ecosystem

Sediments in the Operational Area are expected to be broadly consistent with those in the NWS Province (as described in Section 4.4.4), with filter feeders such as sponges, ascidians, soft corals and gorgonians associated with areas of hard substrate. The only areas of hard substrate expected in the vicinity are artificial habitat associated with subsea infrastructure. Subsea control fluid does not contain any components that are both bioaccumulative and non-biodegradable. Impacts to ecosystems are not expected due to the localised nature of discharge plumes and potential for sediment quality impacts.

Given the nature and scale of planned discharges, potential impacts are considered to be slight and short term (expected to recover once routine discharges cease).

Values and Sensitivities

<u>KEFs</u>

One KEF overlaps the Operational Area—Ancient Coastline at 125 m Depth Contour. No significant escarpments, species of conservation significance, emergent features or areas of high biological productivity characteristically associated with the Ancient Coastline KEF have been observed in the Operational Area (Section 4.5.1.4). Therefore, potential impacts to these regional-scale KEFs are expected to be negligible.

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[12]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
None identified.				
Good Practice				

[12] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[12]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Chemical Selection and Assessment Environment Guideline. • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required. • If chemicals with a different OCNS rating, sub warning or non–OCNS-rated chemicals are required, chemicals will be assessed in accordance with the procedure prior to use.	F: Yes. Woodside routinely implements a chemical selection process based on OCNS at the Okha FPSO. CS: Minimal. The OCNS is widely used throughout the industry and chemical suppliers are aware of the requirements of the scheme.	Selection and assessment of chemicals in accordance with the Woodside process, reduces environmental impacts associated with planned chemical discharge.	Woodside's chemical selection process is used to ensure fluids discharged meet Woodside's chemical environmental risk assessment standards while still providing the required technical capability.	Yes **C 4.1**
Flush subsea infrastructure where practicable during IMMR disconnection activities to reduce volume/concentration of hydrocarbons released to the environment.	F: Yes. The subsea infrastructure has been designed such that much of the hydrocarbon-containing elements can be flushed back to the Okha FPSO. CS: Minor. Flushing may prolong the cessation of production required for subsea IMMR activities, leading to reduced production.	Flushing reduces the volumes/concentration of hydrocarbons release to the environment.	Benefit outweighs cost sacrifice.	Yes **C 4.2**
Limit the volume of subsea control fluid discharged to the marine environment by monitoring subsea control fluid use, investigating material discrepancies, and using subsea control fluid with dye marker.	F: Yes. The use of subsea control fluid is monitored to maintain adequate fluid in the system. CS: Minimal cost.	Limits the volumes of subsea control fluid discharge to the marine environment.	Benefit outweighs cost sacrifice.	Yes **C 4.3**
Monitor routine subsea control fluid discharges in sediments.	F: Yes. Subsea control fluid contains a small volume of low biodegradable components that will be dispersed via the release. CS: Monitoring costs. Costs associated with vessel hire and ROV for an in situ monitoring program would ~$100 K to $200 K (AUD). Can be	Planned discharge associated with valve actuation impact are ranked as slight and short term based on the volume, frequency, location and type of fluid discharged in an open-ocean environment.	Valve operations are the most frequent activity releasing up to 6 L of subsea control fluid each time at a location. Given the small volumes released the plume will be	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[12]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	minimised if tied into existing monitoring programs.		highly localised. The toxic component of each release is 39 ml. 18 ml is readily biodegradable. The remaining 21 ml does not bioaccumulate but may be present in the sediments in the vicinity of the plume. To detect the impacts, any sampling would need to be in the immediate vicinity of subsea infrastructure. If localised impacts to sediment quality are detected, no additional controls can be implemented to reduce impact above those already adopted. Valve actuation is required to maintain technical integrity. Health and safety risks of working on vessels and near live subsea infrastructure to try to detect highly localised sediment impacts mean that the costs of implementing an in situ monitoring program are grossly disproportionate to the environmental consequence.	
Professional Judgement – Eliminate				
None identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Substitute				
Install closed-loop subsea control system.	F: No. Selection of subsea control system (open vs closed) is typically considered within the design phase of a project and therefore retrospective conversation to a closed-loop system is not considered technically feasible. CS: Not considered, control not feasible	Not considered, control not feasible.	Not considered, control not feasible.	No
Change out subsea control fluid.	F: No. Suitable compatible subsea control fluid alternative has not been identified. CS: Minimal. Ongoing cost of supplying subsea control fluid.	Potential reduction in environmental impact associated with an intermittent discharge associated with an open-loop subsea control system.	No reasonable alternative subsea control fluids have been identified. Woodside reviews chemicals with the aim of continuous improvement and is assessing options to replace the current subsea control fluid with an alternative with improved environmental performance. Use of incompatible fluids has the potential to degrade seals in the subsea control system, which may lead to valves being inoperable increasing operational risk. Therefore, currently the risk is considered grossly disproportionate to the environmental benefit.	No (compatibility study in progress; refer to demonstration of acceptability statement below)
Professional Judgement – Engineered Solution				
Route hydrocarbons to vessel during	F: Yes. However, to do so would introduce significant	Small environmental benefit from preventing	Given the increased	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[12]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
disconnection of subsea infrastructure.	safety risks to the vessel crew (fire, explosion, asphyxiation). CS: Significant. Equipping and training crew onboard subsea support vessels to safely route hydrocarbons to the vessel would result in significant additional costs (in addition to the increased safety risk identified above).	low-concentration hydrocarbon discharge.	safety risk and the very low environmental impact from hydrocarbon releases during subsea IMMR activities, the cost of routing hydrocarbons to the vessel is grossly disproportionate to the environmental benefit.	

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of planned routine and non-routine hydrocarbon and chemical discharges. As part of the continuous improvement process alternative subsea control fluids with improved environmental performance are being investigated (described further in Table 7-7) If a suitable alternative is identified, a re-assessment of the controls required to reduce the environmental impact to ALARP will be undertaken. As no reasonable additional/alternative controls can currently be identified that would further reduce the impacts and risks without grossly disproportionate costs, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, planned routine and non-routine subsea hydrocarbon and chemical discharges are unlikely to result in an impact greater than slight, short-term impacts to water quality, marine sediment and ecosystem habitat. Further opportunities to reduce the impacts have been investigated above and are ongoing, as described below. The potential impacts are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of planned routine and non-routine hydrocarbon and chemical discharges to a level that is broadly acceptable.

Continuous Improvement – Alternative subsea control fluid

A compatibility study is in progress to identify potential alternative subsea control fluid products that can be used with Okha's subsea system. However, no suitable alternative has been identified at this time. Refer to Section 7.5.4.4 for Woodside's continuous improvement process and IS PO 10 in Table 7-7, which commits to evaluating alternative subsea control fluids for use on the Okha FPSO facility. The potential impacts from the current subsea control fluid are considered broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 4 Limit water quality impacts to Slight (E) from routine and non-routine hydrocarbon and chemical releases associated with subsea activities during the Petroleum Activities Program.	**C 4.1** Chemical Selection and Assessment Environment Guideline: • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required. • If chemicals with a different OCNS rating, sub warning or non–OCNS-rated chemicals are required, chemicals will be assessed in accordance with the procedure prior to use.	**PS 4.1** All operational chemicals intended or likely to be discharged to the marine environment will be assessed and approved prior to use in accordance with the Chemical Selection and Assessment Environment Guideline (described in Section 3.9.2.4) to ensure the impacts associated with use are ALARP and acceptable.	**MC 4.1.1** Records demonstrate the chemical selection, assessment and approval process for operational chemicals is followed.
	C 4.2 Subsea infrastructure flushed where practicable during IMMR disconnection activities to reduce volume/concentration of hydrocarbons released to the environment.	**PS 4.2** Prior to disconnection, subsea infrastructure containing hydrocarbons will be flushed to the Okha FPSO (where practicable) to a hydrocarbon concentration where further dilution provides disproportionate cost to environmental benefit.	**MC 4.2.1** Records demonstrate subsea infrastructure flushing (to Okha FPSO) where practicable
	C 4.3 Monitor subsea control fluid use, investigate material discrepancies, to support identification of potential integrity failures.	**PS 4.3** Subsea control fluid use monitored and, where losses are unexplained, potential integrity issues are investigated.	**MC 4.3.1** Records demonstrate subsea control fluid use is documented, and unexplained discrepancies investigated.

6.6.5 Routine and Non-Routine Discharges: Produced Water

Context		
Produced Water System – Section 3.6.3	Physical Environment – Section 4.4 Biological Environment – Section 4.5	Stakeholder Consultation – Section 5

Impacts Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Discharge of PW from FPSO.	-	X	X	-	X	X	-	B	E	-	-	LCS GP PJ RBA CV SV	Broadly Acceptable	EPO 5

Description of Source of Impact

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

Produced water discharge is expected to continue for the duration of this EP. In 2018, ~5,823 m^3/day of PW was discharged from the Okha FPSO and discharge rates are expected to continue to increase as reservoirs age. The maximum daily discharge is 18,000 m^3/day (integrity limit); however, based on historical discharge rates actual discharge rates are expected to be much lower. Note: If no PW is discharged, this impact and associated EP requirements would cease.

Monitoring and Management Framework

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

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

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

The relationship between key elements of ecosystem integrity, indicators and relevant monitoring activities undertaken on a routine and non-routine basis are shown in Figure 6-1. As per the EPA guideline (2016), the key elements to maintain ecosystem integrity have been identified as water quality, sediment quality and biological indicators (biota). By limiting the changes to these key elements to an acceptable level there is high confidence ecosystem integrity is maintained. For each element an indicator has been identified and monitoring designed to identify change. Monitoring change in water quality and sediment quality (at representative facilities) as well as investigating potential toxicity via whole effluent toxicity (WET) testing and implementing management to maintain acceptable level of change is standard industry practice in Commonwealth and State Waters. The relevant indicator to understand change in key elements and, therefore, potential for impact to ecosystem integrity, are physicochemical stressors, toxicants in water, biological indicators and toxicants in sediment. A number of trigger values for each indicator have been defined and are monitored to detect change. Trigger values serve as an early warning that potential changes beyond the acceptable limits may occur. The acceptable limits of change are no impacts from PW beyond the approved mixing zone. To determine if acceptable limits have been exceeded, routine monitoring of trigger values is undertaken. An approved mixing zone protects 99% of species, as calculated using the Warne et al. (2018) statistical distribution methodology on the results of direct toxicity assessment using sublethal chronic endpoints. The protection of 99% of species maintains a high level of ecological protection and represents no detectable change from natural variation (as per ANZG 2018).

The approved mixing zone boundary for Okha is 720 m. The justification for these limits of change being 'acceptable' is provided in the impact assessment section below.

Operational Monitoring

OIW monitoring is undertaken via an online analyser. When an elevated OIW concentration is detected, PW is automatically diverted to the PW tank and, if required, either slops tank. PW discharged from the slops tank is monitored by an additional OIW analyser. If both online OIW analysers are unavailable, manual sampling is undertaken. Online analyser information is sent via transmitter to the distributed control system (DCS) and is also captured within the process database. The DCS facilitates visibility in the control room, for manual or automated process control changes to be made, and/or initiate alarms (e.g. high OIW specification). The process database information is available onshore for analysis and trending. The results of manual sampling while the analyser is not available are stored in a spreadsheet contained on the Okha server.

Routine Monitoring

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

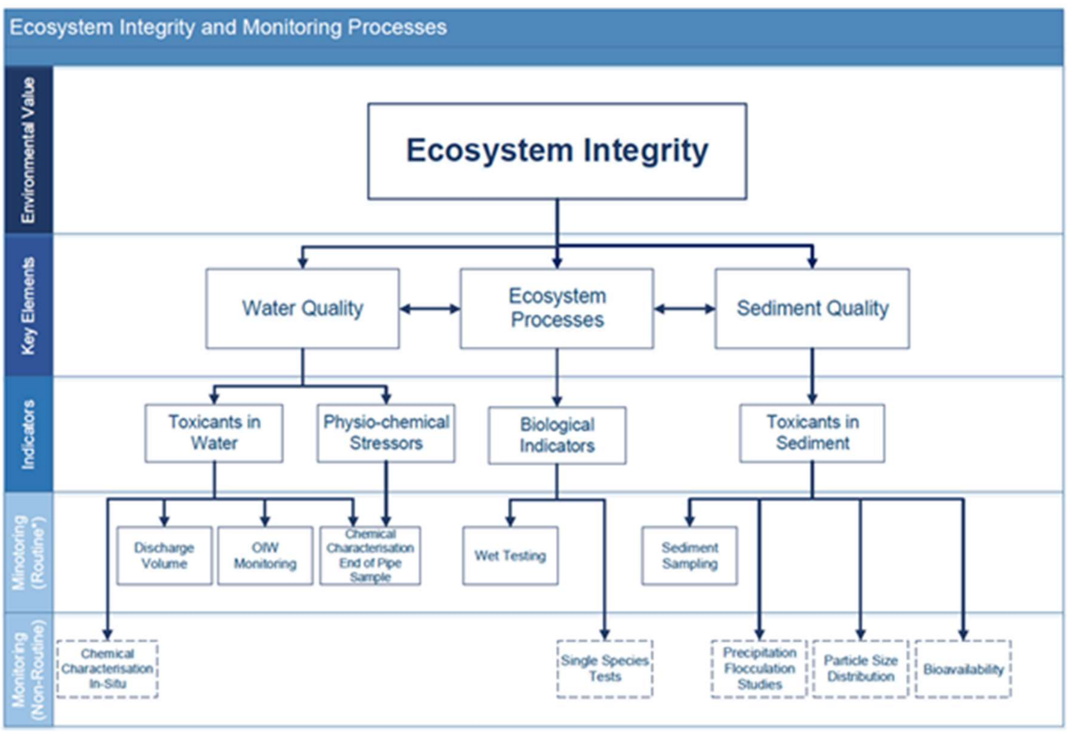

Figure 6-1: Ecosystem integrity and monitoring

The trigger values are applied through a risk-based approach that is intended to capture uncertainty around the level of impact, by staging monitoring and management responses according to the degree of risk to ecosystem integrity. The approach provides a level of confidence that management responses are not triggered too early (i.e. when there is no actual impact), or too late after significant or irreversible damage to the surrounding ecosystem (EPA 2016). Routine monitoring applicable to the facility, to compare against trigger values, is described in Table 6-12. Changes in water quality and raw PW toxicity can be detected early and can indicate the potential for an impact prior to an impact occurring.

WET testing confirms if there is a potential for impact on biota. It is not appropriate to monitor for changes in species composition, diversity etc. as there are limited receptors in the approved mixing zone (a surface-buoyant plume) and such changes may be detected after an impact occurs rather than providing early detection. PW samples should represent normal operations and be undertaken during periods of normal production at the facility. Where practicable, samples are taken at a time when all (or as many as reasonably possible) PW-producing wells are online. The WET tests are undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well-established. WET tests mainly focus on the early life stages of test organisms, when organisms are typically most sensitive to contaminants; the tests are designed to represent local trophic level receptors. For WET testing, a range of tropical and temperate Australian marine species were selected based on their ecological relevance, known sensitivity to contaminants, availability of robust test protocols, and known reproducibility and sensitivity as test species. The dilutions required to protect 99% of species are calculated using the Warne et al. (2018) methodology. The protection of 99% of species maintains a high level of ecological protection at the boundary of the approved mixing zone.

Table 6-12: Trigger values used during routine monitoring

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

Note:

[1] Earlier toxicity year means the year in which the most recent WET test occurred.

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

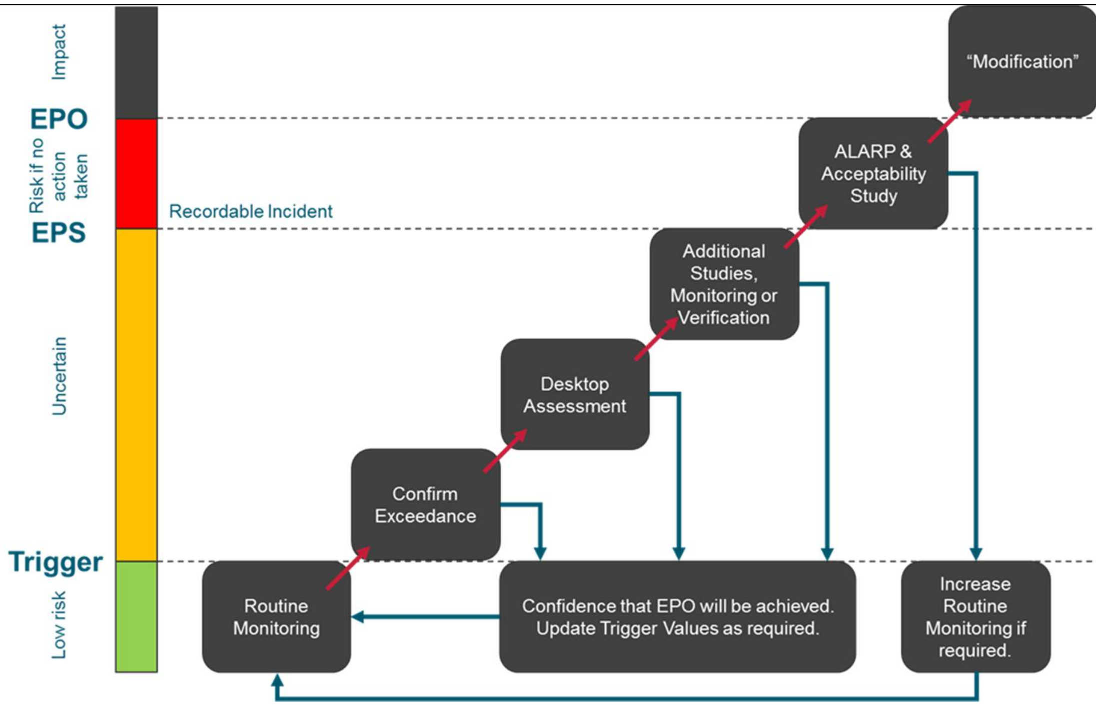

Figure 6-2: Routine monitoring and adaptive management framework for produced water

Further Investigations

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

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

1. **Confirm the trigger value has been exceeded –** Review quality assurance and quality control, methodology and possible sources of contamination to determine if the results are reliable, or if any factors have occurred that may compromise the integrity of the monitoring or data.

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

- Routine monitoring activities may be required ahead of schedule; additional monitoring not listed may be undertaken as appropriate. Field monitoring (routine and non-routine) is undertaken in accordance with a plan that details timing, locations and objectives of monitoring.

3. **Conduct additional studies to confirm the EPS is not at risk** – Monitoring results provide additional lines of evidence to determine whether there is a risk to ecosystem integrity due to changes in water quality, sediment, or biological indicators. Given the significant health, safety and technical risks, monitoring of the receiving environment is typically only considered when all other sources of evidence are insufficient to demonstrate that ecological integrity is not at risk. The OMDAMP provides detailed guidance on the steps and actions to be undertaken if a trigger value is exceeded, and this may include additional non-routine monitoring to verify that ecological integrity is maintained.

If environmental impact is deemed to be within acceptable limits of change, the desktop assessment may consider a review of trigger values to ensure they are appropriate. If the environmental impact is deemed to be outside of acceptable limits of change, an ALARP/Acceptability study is required to determine what additional controls can be implemented to ensure the impacts are acceptable.

ALARP/Acceptability Study

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

The ALARP/Acceptability study shall be conducted in accordance with the ALARP Demonstration Procedure, to determine additional controls that may be necessary. Additional controls may include technology or process upgrades or reservoir management. Woodside will implement the additional controls identified in the ALARP/Acceptability study to maintain acceptable discharge of PW. Field validation of model assumptions, and additional monitoring to assess whether impacts have been realised, is considered

Impact Assessment

Potential impacts of PW discharge include:

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

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

Potential Impacts to Water Quality

PW is discharged from the FPSO either directly overboard below the water (Section 3.6.3) or via the slops tank at the surface. The plume initially plunges and then rises to the surface as positively buoyant plume in both scenarios. Potential impacts to water quality have been assessed through chemical characterisation of PW and potential discharge volumes.

Chemical Characterisation of PW (Physicochemical Parameters and Toxicants)

PW is known to rapidly dilute once discharged into the ocean, with individual constituent concentrations reducing to below respective guideline values within the approved mixing zone (SKM, 2006). Historical monitoring indicates the approved mixing zone has not been exceeded and provides high confidence that impacts from PW discharge are highly localised and pose negligible effects to environmental receptors. Samples of undiluted PW collected annually from the end of pipe between 2011 to 2019 were analysed for key physicochemical parameters and toxicants. In most cases, results are below trigger values, or similar to the results of chemical characterisation when the previous year's WET testing was undertaken (i.e. previous toxicity year), resulting in below guideline values within the approved mixing zone of 720 m after taking into account modelled dilutions.

End of pipe PW analysis in 2018 confirmed chemical composition was similar to 2017 for all physico-chemical parameters, with slight decreases in inorganic and organic chemicals (Jacobs 2018a). BTEX (benzene, toluene, ethylbenzene, and xylene compounds) and phenols were present at levels similar to previous years, and above the ANZG (2018) guideline values, while all metals/ metalloids were either at or below the ANZG (2018) guidelines or derived guideline values. Similar to previous years, PAHs were dominated by naphthalene which was above the ANZG (2018) guideline value and well below the guideline value within the approved mixing zone.

All constituents achieved 99% species protection guideline values within the approved mixing zone of 720 m, with the TPH C6-C36 chain requiring the highest number of dilutions at 168. Modelling (Jacobs 2018b) predicted 903 and 3,131 dilutions would be achieved within 720 m from the discharge point at the maximum discharge rate (18,000 m^3/day) and 2018 average discharge rate (5,823 m^3/day) respectively. When compared to previous years, routine chemical characterisation undertaken in 2018, indicated a stable discharge with no additional non-routine monitoring triggered (Jacobs 2018a).

Chemical characterisation completed in 2019 indicated a slight improvement trend in PW quality. PW was similar to previous years for all physio-chemical parameters, with decreases in concentrations of individual constituents (Jacobs 2019a). All metal/metalloids were below the ANZG (2018) guideline values for 99% species protection or derived guideline values, except total barium, chromium and iron, which were well below the guideline values at the 720 m approved mixing boundary. BTEX, TPHs, PAHs, phenols and volatile organic acids were in line with historical results, with several above guideline values. TPH was mainly comprised of lower carbon chains C6-C9, then C10-C14 and C15-C28, and PAHs were composed mainly of naphthalene, fluorene and phenanthrene. Based on the 2019 results, most required small dilutions, with 3-&4-methylphenol required the highest number of dilutions (91) to be below the guideline values at the boundary of the mixing zone, a decrease in previous years.

PW may include low levels of naturally occurring radionuclides (NORMS) in particular, uranium 238 and thorium 232 decay chains and the longer-lived radionuclides lead 210, polonium 210, radium 226 (Ra-226) and radium 228 (Ra-228) (Coleman and West 2000). These radionuclides can occur in produced water either in solution or as fine mineral suspended solids (OSPAR Commission 2009). During the 2019 chemical characterisation, the concentration of Ra-226, Ra-228, polonium 210 and lead 210 in end of pipe PW was assessed. Concentrations of Ra-226 and Ra-228 in Okha PW were at the lower end of the range of measured values in PWs from different global locations and were 2-3 orders of magnitude higher than background seawater concentrations (Jacobs 2019c, Neff et al., 2011). Currently there are no ANZG (2018) guidelines or international guidance for concentrations of radionuclides in marine water, however, concentrations were similar to the drinking water guidelines (WHO, 2017). Lead 210 and polonium 210 were below the laboratory minimal detectable activity level.

Valeur and Petersen (2013) assessed the ecological hazard related NORMs in PW discharged to the marine environment. They concluded that NORMs have a strong affinity for particulate matter and discharged NORMs would be adsorbed onto fine grained sediments and particulate matter relatively soon after introduction to the marine environment. In high energy environments, NORMs associated particles would settle and resuspend numerous times until they eventually settle in low energy environments in deep parts of the sea that serve as accumulation areas for fine grained sediments. Over time these particles would be buried beneath the benthic mixing layer of the seabed where they will become isolated from the biosphere, and are unlikely to exceed background levels.

Given the low concentrations of radionuclides in Okha PW, its adsorption to fine grained sediments, no further investigation or analysis will be undertaken as the approved 720 m mixing zone is deemed appropriate . Potential toxicity risk would be accounted for during regular WET testing to determine PW toxicity.

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

Discharge Volumes

The average daily volume of PW discharged from the facility in 2018 was 5,823 m^3/day and PW discharges have consistently been lower than the maximum capacity of the PW system that was modelled (18,000 m^3/day). Based on historical discharge rates, future discharges are expected to increase as the fields age.

Potential Impacts to Biota

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

WET Testing

The cumulative impacts of residual process chemicals in combination with naturally occurring constituents including NORMS is typically unknown (Bakke et al 2013). Routine WET monitoring enables understanding of the cumulative risk of these discharges, as it incorporates and accounts for toxicants which cannot be readily measured, or are not known to be present in the sample, and allows for interactions between toxicants within the sample. WET testing is undertaken at end of pipe, and takes into account total PW toxicity, and incorporates characteristics identified during the chemical characterisation including, but not limited to BTEX, PAHs, TRH and physio-chemical parameters.

A total of eight toxicity tests are carried out on a range of tropical and temperate Australian marine species. These are selected based on their ecological relevance, known sensitivity to contaminants, availability of robust test protocols and known reproducibility and sensitivity as test species for assessing PW in marine environments. Upon completion of WET testing, the results are combined into safe dilution estimates for the protection of 99% species.

Routine WET testing was completed as required by the previous revision of the EP in 2017 and 2014 (Table 6-13) and is scheduled to be undertaken in 2020. The number of dilutions required to achieve 99% species protection safe dilutions in 2017 was similar to the previous testing.

Table 6-13: Protection Concentration (PC) 99% concentrations and safe dilutions

Species Protection Level	Predicted No Effect Concentrations (PNEC) concentrations		
PCx	***2006***	***2014***	***2017***
PC99 (50)	0.31 (1 in 320)	0.15 (1 in 670)	0.29 (1 in 345)

Determination of Approved Mixing Zone

To determine the potential impact of the PW to the marine environment, modelling was conducted to predict the distance at which 99% species protection safe dilutions are achieved, using the most recent WET testing results available at the time to reflect the current potential toxicity (Table 6-13). The latest modelling study was carried out in 2018 and informs this impact assessment (Jacobs 2018).

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

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

The results from the WET testing undertaken in 2017 were used to develop PNEC values that were inputs to the model. The four-day averaged PW concentrations provide estimates of the mean in situ exposure concentration. The four-day PEC (Predicted Effects Concentration) value is used to determine the PEC/PNEC ratios and the distances from the discharge point at which 99% species protection safe dilutions (PC99) are achieved, based on the 2017 discharge rate (5,209 m^3/day) and maximum discharge rate (18,000 m^3/day). The modelling shows a surface-buoyant plume that is readily diluted to 99% species protection safe dilution within 720 m of the discharge location under worst-case conditions at actual and maximum discharge rates. Therefore, it is proposed to maintain a 720 m approved mixing zone to reflect 99% species protection safe dilutions at the maximum expected discharge 18,000 m^3/day.

Impacts to AMPs, KEFs and BIAs

The Okha FPSO is moored ~10 km from the nearest KEF (the Ancient Coastline at 125m Depth Contour) and 92 km from the Montebello AMP (Figure 6-3). Glomar Shoal is ~12 km away from the mixing zone, further than the Ancient Coastline KEF. Given PW forms a buoyant plume and the distance from the discharge source, no impacts to the Marine Park or KEF are anticipated. Routine monitoring (end of pipe chemical characterisation and WET testing) detects changes at the approved mixing zone boundary. If trigger values are predicted to be exceeded at this distance further investigation is required as described above. This may include reviewing single species toxicity test results, additional WET testing or in situ monitoring. If trigger values are not exceeded, there can be high confidence that maximum ecological protection is achieved by the Montebello AMP.

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

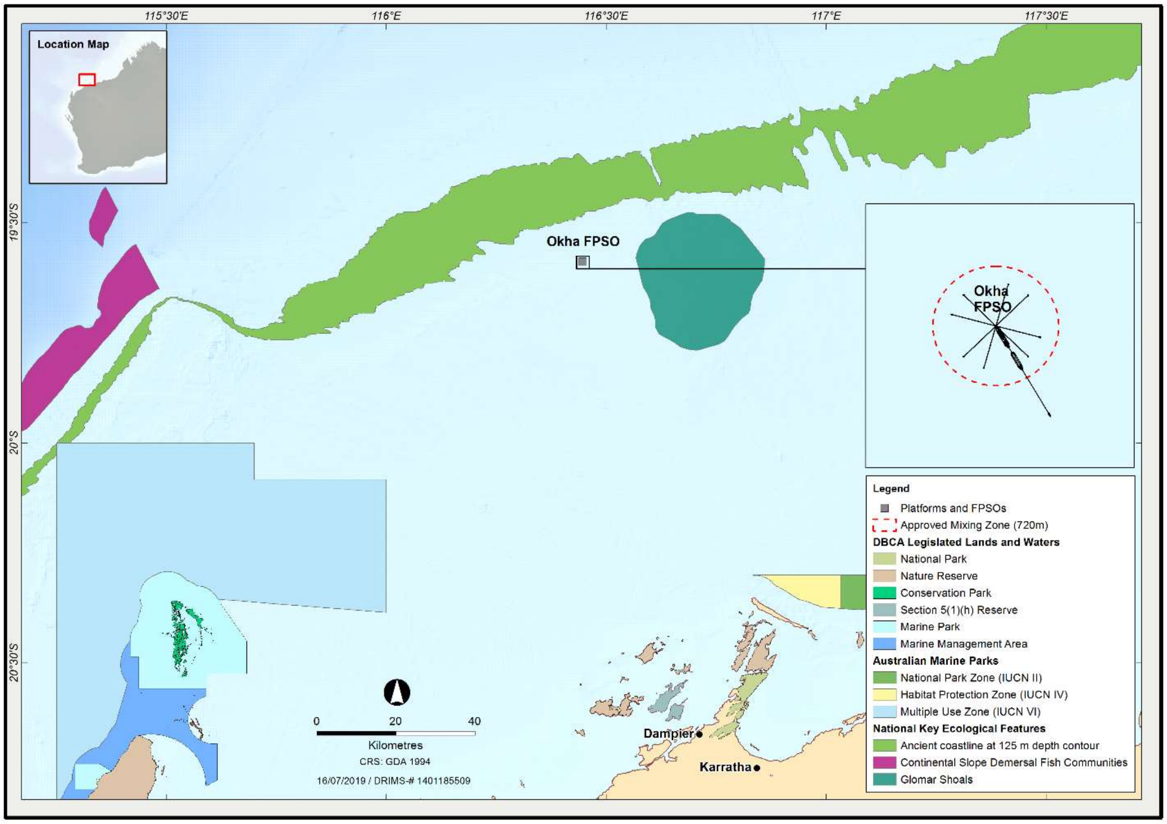

Figure 6-3: PW approved mixing zone relative to AMPs and KEFs

Bioaccumulation

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

The average concentration of BTEX in PW discharged from the facility is ~6 mg/L (Jacobs 2018) Bioaccumulation of BTEX compounds has been observed to occur in the laboratory, but only at concentrations far in excess of that discharged from the Okha FPSO (e.g. refer to Berry 1980); hence, it is unlikely BTEX would bioaccumulate at the exposure concentrations that may be experienced by biota around the FPSO.

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

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

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

Therefore, bioaccumulation is unlikely to result in increased levels of BTEX in biota surrounding Okha; however, there may be an elevation in PAH levels. The results from Neff et al. (2011) can be used to infer the very low potential for adverse bioaccumulation effects to marine organisms, or to humans, if they were to consume any affected fish, molluscs or crabs found on upper near-surface legs of the facility. The potential environmental impact associated with bioaccumulation of PW constituents in the water column and in the sediments, is considered to be very low, and limited to a potential localised effect on a small number of non-threatened species in waters immediately surrounding the facility, as described below. Potential health risks are unlikely as a result of negligible exposure: the PSZ prohibits fishing from or near the facility as there is very little or no activity within the Operational Area. The findings of the Routine Sediment Sampling/Analysis and Water Quality Monitoring field studies completed in 2014 at Okha (BMT Oceanica 2015) validated the conclusion that states, '*the potential environmental impact associated with bioaccumulation of PW constituents in the water column and in the sediments, is considered to be very low and limited to a potential localised effect on a small number of non-threated species in waters immediately surrounding each facility'*. Given the nature of the PW discharge from the FPSO, the potential for bioaccumulation of PW contaminants (in particular BTEX) is considered to be highly localised with no lasting effect.

Potential Impacts to Sediment Quality

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

<u>Toxicants in sediments</u>

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

The plume is buoyant, due to lower salinity and/or higher temperature than surrounding sea water. Therefore, potential contaminants in the PW discharge may be introduced into sediments around the FPSO through precipitation of soluble contaminants and flocculation and sedimentation of the particles in the PW plume. Studies into potential sediment accumulation from PW discharge have been undertaken by Woodside, including analysis of a sample of PW from the facility (Jacobs 2016). The study found that the PW at Okha has very small amounts of solid material, with very little potential of settling out due to small particle sizes (100% particles <40 μm), and that it is unlikely to flocculate.

Dr Graeme Hubbert categorised particulate behaviour based on oceanographic experience and mathematical calculations using settling rates and resuspension velocities for various particle sizes. He determined that particles of a size 1 to 5 μm would never permanently settle out of the water column, and that particles from 5 to 40 μm would not permanently settle out of the water column, unless they were in very deep water (>5000 m) or in areas where hydrodynamic conditions were very weak and did not continuously resuspend the particles (SKM 2013). All the particles in Okha PW were smaller than 40 μm (Jacobs 2016), and therefore have little chance of settling within the dynamic open ocean environment surrounding the facility.

In 2014, sediment sampling was conducted at Okha to verify impacts to sediment were not observed from PW discharges (BMT Oceanica 2015). The Australian and New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000a) Australian interim sediment quality guideline (ISQG) -Low and -High values for metals with existing guidelines were met in all samples at all sites around the Okha FPSO. Non-routine sediment sampling is scheduled to occur prior to 2022 to ascertain if impacts to sediment quality outside of the approved mixing zone have occurred. Toxicant concentrations in sediments are influenced by natural variability in sediment granulometry and mineralogical composition and therefore a number of replicates are collected at each site. The mean concentrations are compared against national guidelines to ascertain if the trigger (Table 6-14) has been exceeded. Should the trigger value be exceeded further investigations as described above and managed via the OMDAMP are implemented and could include:

- cross checks against background concentrations
- evaluation of other lines of evidence
- applying a weight of evidence framework
- review of PW chemical characterisation

If there is potential for PW to impact ecosystem integrity; an ALARP/Acceptability study is required to determine what additional controls can be implemented to ensure the impacts are not realised. A sampling plan to demonstrate compliance with the approved mixing zone boundary will be developed for the sediment survey. The sampling plan outlines and justifies sampling locations and when concentration and bioavailability testing is to occur.

Table 6-1414: Protection Concentration (PC) 99% concentrations and safe dilutions

Parameter	Trigger Value
Sediment sampling	Results that are higher than the low trigger guideline values[1], detailed in the national guidelines, at the boundary of the approved mixing zone.

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

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
None identified.				
Good Practice				
Chemical Selection and Assessment Environment Guideline (Woodside Doc No. WM0000MG9905057): • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected, no further control required. • If chemicals with a different OCNS rating, sub warning or non–OCNS-rated chemicals are required, chemicals are assessed in accordance with the procedure prior to use.	F: Yes. Woodside routinely implements a chemical selection process based on OCNS at Okha. CS: Minimal. The OCNS is widely used throughout the industry, and chemical suppliers are aware of the requirements of the scheme.	Selection and assessment of chemicals in accordance with the Woodside process reduces environmental impacts associated with planned chemical discharge.	Woodside's chemical selection process is used to ensure fluids discharged meet Woodside's chemical environmental risk assessment standards while still providing the required technical capability.	Yes **C 4.1**
Monitor and manage OIW concentrations in accordance with former Paris Convention 1997/16 (PARCOM) Annex 3 methodology: • Limiting average PW OIW to less than 30 mg/L (over a rolling 24-hour period).	F: Yes. CS: Monitoring and implementation costs. Standard practice. The 30 mg/L limit proposed is a legacy of the former OPGGS Environment Regulations 29 and 29A repealed in 2014. Reduction of this limit is not considered feasible or practicable. The current limit is effective in managing risk of PW discharge.	Limiting OIW concentrations within PW reduces impacts to the environment.	The adoption of a limit ensures PW OIW is controlled.	Yes **C 5.1**
Inboard off-specification PW to maintain OIW concentrations below 30 mg/L.	F: Yes CS: Monitoring and implementation costs. Standard practice.	Inboarding of PW is a contingency measure to ensure that rolling 24-hour period limits are not exceeded, even if a	If the facility exceeds 30 mg/L for a short period, which places the rolling 24-hour period limit at risk,	Yes **C 5.2**

[13] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
		temporary spike in OIW concentration occurs.	the facility is able to inboard PW for further separation in the PW tank and/or slops tank, to ensure a breach of the OIW limit does not occur. This control achieves the same performance standard as the monitoring of OIW concentrations control.	
Implement the Monitoring and Management Framework for PW including: • monitoring of PW discharge volume • chemical characterisation • WET testing.	F: Yes. CS: Monitoring costs. Standard practice.	The OMDAMP manages significant changes to the PW discharge characteristics (i.e. volumes, OIW concentration, chemical dosage) that may cause an increased impact or risk to the marine environment. By implementing the OMDAMP, potential risks to the environment are reduced.	Woodside has been operating a number of offshore facilities (including Okha) for a considerable period and has developed the OMDAMP based on operational experience. The OMDAMP considers risk-based adaptive management measures.	Yes **C 5.3**
Online monitoring and/or procedural controls in place to monitor and control PW OIW concentrations and prevent discharge of PW with high OIW concentrations. Process performance monitored by OIW analyser. Conduct manual sampling on a 6-hourly basis if online analyser is unavailable, where safe and practicable to do so.	F: Yes. CS: Minimal cost. Standard practice.	The OIW analyser provides optimal process control and safeguarding to monitor, control and prevent discharge of PW with high OIW concentration to the environment. High OIW PW is inboarded for further separation then a second OIW analyser is installed to monitor, control and prevent discharge of PW with high OIW concentration to the environment after inboarding. Monitoring of OIW concentrations when online analyser unavailable when	Control is WMS requirement – must be adopted.	Yes **C 5.4**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
		safe and practicable to do so.		
The online analysers are calibrated with a manual sample analyser in accordance with Laboratory Procedure AN-M-140.	F: Yes CS: Monitoring and implementation costs. Standard practice.	Calibration of equipment to maintain quality control.	Calibrations undertaken at appropriate frequency to maintain quality control and in line with procedures.	Yes **C 5.5**
Professional Judgement – Elimination				
Reinjection of PW into reservoirs.	F: Potentially feasible – some technical risk associated with reservoir uncertainty. CS: Significant. The reinjection of PW would require significant modification to the facility, including drilling injection wells. This would require considerable design and construction costs. Previous studies indicate a cost in excess of $20 million AUD capital expenditure (CAPEX) for PW reinjection, with an estimated operating expenditure (OPEX) cost of $1 million. Additionally, drilling rig activities associated with drilling an injection well introduce environment impacts (from cuttings discharges) and health and safety risks associated with the drilling campaign.	The environmental impacts in the approved mixing zone around the facility would be eliminated whilst reinjection is online. Long-term biological impacts from PW that are outside acceptable limits of change (i.e. impacts to ecosystems' integrity from contaminant accumulation in sediment and bioaccumulation effects over time) are prevented by the PW Monitoring and Management Framework. Currently, PW does not represent a sediment accumulation or resulting bioaccumulation risk (refer to potential impacts to sediment quality for more detail).	As part of the 2015 PW study into treatment, Woodside examined the potential for reinjection of PW at NWS facilities. Woodside has not identified a suitable reservoir, and such an option would likely require additional drilling activities to be undertaken. Reinjection is not feasible unless a suitable reservoir is identified. It is not feasible to reinject into a shut-in production well because the wells continue to have very high reservoir pressure, which would require significant facility modifications to overcome. Drilling and subsea work activities to establish a reliable PW reinjection well and subsea infrastructure also introduce significant complexity, risk and cost. Retrofitting PW topsides reinjection equipment to the FPSO introduces significant modifications, which pose safety	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
			risks on an operational facility. Together the significant retrofit risks, associated environmental impact (drilling and subsea construction) and introduced health and safety risks are considered significantly disproportionate to the potential slight environmental impact improvement. As such, no further engineering design or screening studies reporting is considered reasonably practicable. For Type B impacts, it is appropriate to consider case-specific drivers to ALARP management. The lack of a suitable reservoir contrasts with Woodside's facilities that currently reinject PW. At a similar FPSO, for example, water reinjection is required to maintain reservoir pressure for production and was a key part of the Field Development Plan to optimise overall field recovery. As PW alone is not sufficient to maintain reservoir pressure, sea water is used to make up the balance. Therefore, given the significant economic benefits associated with	

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
			reinjection at this FPSO the ALARP outcome is different to Okha. The reinjection of PW would also introduce additional sources of environmental risks and impacts, such as those associated with drilling injection wells (e.g. drilling cuttings) and maintaining injection capability (e.g. increased greenhouse gas emissions from power generation for pumps, increased chemical usage). Given the localised, slight, impact of PW discharges, and the considerable costs involved in developing a PW reinjection capability for the Okha, implementation risks and environmental impacts (greenhouse gas, chemical use), the costs are grossly disproportionate to the potential environmental benefit gained.	
Professional Judgement – Substitution				
None identified.				
Professional Judgement – Engineered Solution				
Chemical injection of water clarifier to reduce OIW concentration.	F: Potentially feasible. CS: Moderate. Initial cost of modifying production system to include chemical dosing point. Ongoing cost of chemical procurement.	C: Potential minor reduction in OIW concentration; however, does not reduce the overall consequence rating. Further, this results in additional chemical load, and lifecycle	The discharge of the clarifying agent with the PW stream may result in additional toxic effects. Ongoing chemical consumption would also incur OPEX.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
		environmental footprint associated with packaging, logistics, waste management and potential process upsets.	Given the nature and scale of impacts forming the current PW discharge, the cost of developing a chemical injection is disproportional to the environmental benefit.	
Adopting a tertiary treatment stage to reduce OIW concentration.	F: Potentially feasible. Large deck space would be needed which is not currently available. CS: Significant cost. Deck reinforcement or cantilevers required, as well as high cost associated with these maintenance-intensive technologies. Previous studies for a similar NWS facility indicate a cost of $5–15 million CAPEX for tertiary treatment stage technology, with an estimated annual OPEX cost of $250,000–750,000 AUD.	Potential minor reduction in OIW concentration; however, does not reduce the overall consequence rating. Further, there is very little deck space available at Okha for additional treatment equipment.	Macro porous polymer extraction equipment is large and heavy, requiring deck reinforcement or cantilevers. It is also maintenance intensive. This introduces significant costs and additional risk from exposure of personnel. Additionally, these options tend to have high power consumption. The adoption of tertiary treatment is not currently considered ALARP because the additional costs and risks associated with this option are considered disproportionate to the OIW benefit.	No

Professional Judgement - Procedure and Administration

None identified.

Risk Based Analysis

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

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

Company Values

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

Societal Values

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[13]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Due to the Petroleum Activities Program's proximity to sensitive receptors and potential uncertainty around PW discharges, the PW discharge consequence rating presents a Decision Type B in accordance with the decision support framework described in Section 2.6.1. Extensive consultation was undertaken for this program to identify the views and concerns of relevant stakeholders, as described in Section 5.				
ALARP Statement On the basis of the environmental impact and risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of PW discharge. Woodside has undertaken RBA (PW discharge modelling) to inform the evaluation and assessment of environmental impacts and risks. Woodside also implements a risk-based adaptive OMDAMP. The outcomes of both the modelling studies and long-term monitoring were considered in determining the ALARP position. As no reasonable additional/alternative controls are currently identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability

To assess and determine the acceptable limits of impacts from PW discharges, Woodside has considered appropriate guidelines, principles of ESD, CVs and SVs. Refer to the details below for additional discussion.

Other Requirements (includes laws, polices, standards and conventions)

The adopted controls and acceptability assessment have considered regulatory guidance, in particular WA EPA (2016) Technical Guidance: Protecting the Quality of Western Australia's Marine Environment and the ANZECC/ARMCANZ (2018) guidelines. Both sources of regulatory guidance provide that environmental values should be identified, and levels of ecological protection should then be set. To ensure ecosystem health is maintained overall, the cumulative size of the areas where lower levels of ecological protection apply should be proportionally small compared to the areas designated high and maximum. The ANZECC/ARMCANZ (2018) guidelines similarly provide guidance that levels of protection should be identified, based on the environmental values to be protected.

The Monitoring and Management Framework aligns to the levels of protection described by both WA EPA (2016) Technical Guidance and the ANZECC/ARMCANZ (2018) guidelines through the acceptable limit of change. The level of ecological protection provided to sensitive receptors (located 10 and 92 km away) is consistent with the North-west Marine Parks Network Management Plan (2018). By monitoring and managing to the 99% species protection safe dilutions (high level of ecological protection) at 720 m, there can be high confidence that any potential for impacts can be detected and managed via the OMDAMP.

Principles of ESD

Woodside has a strong history of exploration and development of oil and gas reserves in the north-west of WA with an excellent environmental record, while providing revenue to State and Commonwealth governments, returns to shareholders, jobs and support to local communities. Titles for oil and gas exploration are released based on commitments to explore with the aim of uncovering and developing resources. It is under the petroleum title lease agreement that Woodside has determined the potential to develop the hydrocarbon fields for which acceptance of this EP is sought under the Environment Regulations.

Woodside has established a number of research projects in order to understand the marine environments in which facilities are operated, notably in the Exmouth Region and the Kimberley Region, including Rankin Bank, Glomar Shoal, Enfield Canyon and Scott Reef. Where scientific data does not exist, Woodside assumes a pristine natural environment exists and therefore implements all practicable steps to prevent damage. Woodside's corporate values require consideration of the environment and communities 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 potential impact is slight, short term and discharge of PW is acceptable.

Internal Context

The Petroleum Activities Program is consistent with Woodside corporate policies, standards, procedures, processes and training requirements as outlined in the Demonstration of ALARP (above) and EPOs (below), including:

- Woodside Health, Safety, Environment and Quality Policy (Appendix A)
- Woodside Risk Management Policy (Appendix A)
- Woodside Environmental Performance Procedure (which specifies maximum mixing zones and minimum sampling requirements).

Given that an approved mixing zone has been established at 720 m, the proposed limits of acceptable change meet the requirements of the Environmental Performance Procedure.

Woodside corporate values include working sustainably with respect to the environment and communities in which it operates, listening to internal and external stakeholders, and considering HSE when making decisions. Stakeholder consultation, outlined below, was undertaken prior to the Petroleum Activities Program.

External Context

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 (Section 5) was undertaken prior to the Petroleum Activities Program and stakeholder feedback (Appendix F) was incorporated into this EP where appropriate.

Woodside believes that providing PW monitoring and control measures that are commensurate with the risk rating, location and sensitivity of the receiving environment (including social and aesthetic values), any societal concerns are addressed to an acceptable level.

In addition, the Petroleum Activities Program is consistent with the objectives in the Ningaloo management plans (Management Plan for Ningaloo Marine Park and Muiron Islands Marine Management Areas, Ningaloo Marine Park Management Plan). Considerations regarding water quality, coral, shoreline and intertidal, macroalgal, seagrass, mangroves, seabirds and social and economic values are consistent with these management plans.

Environmental Performance Outcomes, Standards and Measurement Criteria

Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 5 No impact to ecosystem integrity from PW outside the approved mixing zone boundary.	**C 4.1** Refer to Section 6.6.4	**PS 4.1** Refer to Section 6.6.4	**MC 4.1.1** Refer to Section 6.6.4
	C 5.1 Monitor and manage OIW concentrations in accordance with PARCOM 1997/16 Annex 3 methodology. • Limiting average PW OIW to less than 30 mg/L (over a rolling 24-hour period).	**PS 5.1** OIW discharge is limited to a 30 mg/L concentration over a 24-hour rolling average.	**MC 5.1.1** Records demonstrate OIW rolling average limits are not exceeded.
	C 5.2 Inboard off-specification PW to maintain OIW concentrations below 30 mg/L.		
	C 5.3 Implement the Monitoring and Management Framework for PW including: • monitoring of PW discharge volume • chemical characterisation • WET testing.	**PS 5.3** No potential to impact ecosystem integrity from PW outside acceptable limits of change. The acceptable limit of change is no impacts from PW beyond the approved mixing zone.	**MC 5.3.1** Records show routine monitoring has been conducted as per Table 6-12. Further investigations have identified no potential to impact ecosystem integrity from PW outside the acceptable limits.
	C 5.4 Online monitoring and/or procedural controls in place to monitor and control PW OIW concentrations and prevent discharge of PW with high OIW concentrations. Process performance monitored by OIW concentration analyser.	**PS 5.4 (a)** Instrumentation integrity is managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE Technical Performance Standard(s) P31 – Environmental Emissions Monitoring and Controls, which:	**MC 5.4.1 (a)** Records demonstrate implementation of SCE Technical Performance Standard(s) and SCE Management Procedure. **MC 5.4.1 (b)** Records demonstrate manual sampling and calibration is

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	Conduct manual sampling on a 6-hourly basis if online analyser is unavailable, where safe and practicable to do so.	• provides means of detecting environmental releases, emissions and discharges to prevent MEEs from manifesting over time, and/or assure compliance monitoring and reporting equipment as required. • ensure monitoring data is available to control PW discharge volume and OIW concentrations • prevent discharge of PW with high OIW concentrations. **PS 5.4 (b)** If the OIW analyser is offline, manual sampling is undertaken when safe and practicable to do so. Six-hourly samples are taken in accordance with the Okha's sampling requirements	undertaken as appropriate.
	C 5.5 The online analyser is calibrated with a manual sample analyser in accordance with Laboratory Procedure AN-M-140.	**PS 5.5** Complete calibrations of online analyser and manual OIW sampling equipment in accordance with Laboratory Procedure.	**MC 5.5.1** Refer to MC 5.4.1 (b)

6.6.6 Routine and Non-routine Discharges: Discharges from Utility Systems and Drains

Context	
Process Description – Section 3.6.2 Facility Utility Systems – Section 3.6.8 Facility Operations – Section 3.6.9	Physical Environment – Section 4.4 Biological Environment – Section 4.5

Impact Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*							
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact		Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Discharge of sewage, greywater and putrescible waste from FPSO and vessels to the marine environment.	-	-	X	-	X	-	-	A	F	Cumulative E	-	-	LCS GP PJ	Broadly Acceptable	EPO 6
Discharge of deck water from FPSO and bilge water from vessels to the marine environment.	-	-	X	-	X	-	-	A	F		-	-			
Discharge of brine from vessels and FPSO to the marine environment.	-	-	X	-	X	-	-	A	F		-	-			
Discharge of cooling water from FPSO and vessels to the marine environment.	-	-	X	-	X	-	-	A	F		-	-			

Description of Source of Impact

Sewage, Putrescible Waste and Greywater

Sewage and greywater are treated onboard the FPSO by a biological sewage treatment plant that includes maceration, biological treatment and disinfection. The sewage treatment plant onboard the FPSO is capable of handling inputs from up to 80 people, which is adequate for routine and non-routine personnel levels onboard the FPSO. Sewage treatment on facility support and subsea vessels varies. Treatment systems may require routine maintenance or repair during operations, which may necessitate infrequent, short periods in which sewage is directly discharged overboard.

Putrescible wastes (e.g. food scraps) from the FPSO and vessels may be macerated before being discharged overboard. Putrescible wastes may also be retained onboard and disposed onshore.

The volume of sewage, greywater and putrescible waste generated is estimated to be ~6 m^3 per day (based on an average volume of 75 L/person/day). The actual volume of discharge varies depending on personnel levels on the

FPSO and vessels. Treated sewage and greywater discharge from the FPSO is directly to the sea via the hull discharge line below the sea surface. Discharge locations from vessels may vary; however, discharges are typically at or near the water surface.

Drains system

Operational non-process discharges, process maintenance drainage and flushing discharges, washdown water and potential spills are contained in the non-hazardous and hazardous open drain systems onboard the FPSO. These systems drain to the slops tank for treatment (as described in Section 3.6.4) before being discharged overboard. Machinery space bilges on the FPSO also drain to the slops tank. The maintenance drain system leads to the rundown and blanket gas headers and collects spills and maintenance discharges from the compressor scrubbers and separators.

Chemicals used on the FPSO may be introduced to drains system, including:

- deck washdown, maintenance drainage of treated water systems (e.g. cooling medium), and other cleaning/flushing activities;
- mandatory annual testing of the active fire deluge and foam system for safety requirements
- marine growth treatment of drain system.

Mandatory testing of the active fire deluge and foam system on the FPSO is undertaken for safety requirements. This discharge is directed overboard to prevent foam contamination of the slops tank (which would decrease the effectiveness of gravity separation of hydrocarbons). Rainwater on the FPSO is also directed overboard instead of to the slops tanks.

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

Brine

The freshwater generators on the FPSO are used to produce potable water, with the brine discharged to the marine environment. Brine is generally 55–60 parts per thousand salt, with up to ~60 m^3 of brine produced per day. Small quantities of anti-scaling and cleaning chemicals may also be discharged with the brine. Small quantities of reverse osmosis (RO) brine may be generated by support or subsea vessels.

Seawater Systems (including Cooling Water)

The seawater systems on the FPSO are routinely used for process and machinery cooling; discharges are returned to the sea via the seawater disposal system or via marine sea chests for the vessel cooling system. Seawater used for cooling uses hypochlorite generation to inhibit marine growth. The average discharge rates of sea water from the topsides cooling system and hull seawater cooling systems are ~47,400 m^3/day and 9,600 m^3/day respectively. The maximum seawater discharge temperature from both systems is 60° C.

Impact Assessment

Sewage, Putrescible Waste and Greywater

The main environmental impact associated with ocean disposal of sewage, greywater and putrescible waste is eutrophication. Eutrophication occurs when the addition of nutrients, such as nitrates and phosphates, causes adverse changes to the ecosystem, such as oxygen depletion and phytoplankton blooms

No significant impacts from the planned (routine and non-routine) discharges to the marine environment are anticipated given the minor quantities involved, the expected localised mixing zone, and high level of dilution into the open water marine environment of the Operational Area.

Although the NWS Province is characterised as a low nutrient environment (DEWHA 2008), studies of adjacent shelf water have found the area to be 'a highly productive ecosystem in which nutrients and organic matter are rapidly recycled' (Furnas and Mitchell 1999). The estimated daily loading from sewage and putrescible waste from vessels (approximately 0.075 m^3 a person per day) is not significant compared to the daily turnover of nutrients in the area. Furthermore, vessels are typically moving when in the Operational Area, which facilitates the mixing of sewage, putrescible wastes and greywater from vessels.

This assessment is supported by infield monitoring undertaken around the GWA platform. A facility with typically more personnel onboard will discharge larger volumes of sewage and putrescible waste than a vessel. Monitoring at GWA indicated there was no detectable decrease in oxygen saturation, nutrients or increase in oxygen demand at the GWA platform (BMT Oceanica 2015b). In addition, monitoring of sewage discharge demonstrated that a 10 m^3 sewage discharge reduces to ~1% of its original concentration within 50 m of the discharge location (Woodside 2008).

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

Drains System

The slops tank receives inputs from a range of sources, including Okha FPSO drain systems. Slops tank water may contain small quantities of dissolved and residual hydrocarbons, and other chemicals such as detergents and cleaning agents. The impacts of discharge from the slops tank can include a decline in water quality and may directly affect marine organisms, with impacts varying depending on volumes discharged and the type of contaminants. Impacts from the discharge of the slops tank are assessed as being highly localised, with no lasting effect due to the rapid dilution and dispersion.

Water-foaming agents used in firefighting foam may be harmful to aquatic organisms in freshwater environments like ponds and streams. This effect of this chemical release is greatly diminished in the offshore environment (due to wave and wind action) and does not present the same risks to pelagic fish and other marine life as it is rapidly dispersed. Nevertheless, the planned release of these materials is restricted to testing activities to ensure safe and effective operation of the system in an emergency.

Bilge and deck drainage from vessels are expected to mix rapidly in the marine environment upon discharge. Given the rapid mixing, relatively small typical bilge and deck drainage water volumes, and expected low levels of potential contaminants, impacts from bilge and deck drainage water from vessels and the facility are assessed as highly localised with no lasting effect.

Brine

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

Once discharged into the marine environment, the brine plume is expected to sink due to its relatively high density. Sinking of the plume will facilitate turbulent mixing, as will surface currents and waves. Recent water quality monitoring at the Okha FPSO indicated the brine plume mixed rapidly once released and was not readily detectable within 50 m of the discharge location (BMT Oceanica 2015). On this basis, the RO brine plume is expected to mix rapidly. Impacts from RO brine discharge will have no lasting effects on the environment and are highly localised to the discharge location.

Cooling Water

The impacts of cooling water can include a decline in water quality and may directly affect marine organisms due to temperature changes, with impacts varying depending on volumes, temperature and type of contaminants.

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

Monitoring in the mixing zone around a similar FPSO (the NY FPSO),could not detect elevated temperatures (SKM, 2010), indicating that temperatures returned to ambient within 10 m of the discharge point. Given the Okha FPSO typically discharges 57,000 m^3/day compared to the 136,000 m^3/day discharged by NY, temperature elevation is

expected to be undetectable within 10 m of the discharge point. No significant impacts from the planned discharges to environmental receptors are anticipated because of the localised mixing zone and high level of dilution into the open water marine environment. Sodium hypochlorite is used in the cooling system to control biofouling, and is expected to readily dissociate and break down once discharged. Cooling water from the Okha FPSO may contain small quantities of total residual chlorine (TRC). Okha's cooling water is dosed at 2 ppm TRC; once through the system and discharged, it is expected this will be reduced to <1 ppm TRC. Modelling of the TRC was undertaken for NRC (SKM 2008) at TRC concentration of 1 ppm and a higher discharge flow rate. In all scenarios, the modelled concentrations were below the PNEC for acute and chronic effects at 200 m distance from the discharge. The modelling report also states that discharged TRC would need to be 2.7 ppm before the acute or chronic PNEC is not reached at 200 m from the discharge source. Therefore, discharges are well below the 2.7 ppm within a 200 m mixing zone. Impacts from cooling water from the Okha FPSO are assessed as being highly localised and short-lasting and are anticipated to have no lasting effects on the environment.

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Ohka FPSO and support vessels compliant with: • Marine Order 91 (Marine pollution prevention – oil) • Marine Order 95 (Marine pollution prevention – garbage) • Marine Order 96 (Marine pollution prevention – sewage).	F: Yes. CS: Minimal cost. Standard Practice.	Marine Orders required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class. Marine Orders 91, 95 and 96 reduce the potential impact of marine wastewater discharges on water quality.	Controls based on legislative requirements – must be adopted.	Yes **C 6.1**
Good Practice				
Chemical Selection and Assessment Environment Guideline: • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required. • If chemicals with a different OCNS rating, sub warning or non–OCNS-rated chemicals are required, chemicals will be assessed in accordance with the procedure prior to use.	F: Yes. Woodside routinely implements a chemical selection process at the Okha FPSO, which is based on OCNS. CS: Minimal. The OCNS is widely used throughout the industry and chemical suppliers are aware of the requirements of the scheme.	Selection and assessment of chemicals in accordance with the Woodside process reduces environmental impacts associated with planned chemical discharge.	Woodside's chemical selection process is used to ensure fluids discharged meet Woodside's chemical environmental risk assessment standards while still providing the required technical capability.	Yes **C 4.1**

[14] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Putrescible waste macerated prior to overboard discharge to increase dispersion, thus reducing impact of discharge on water quality	F: Yes CS: Minimal cost. Standard practice.	Treating and macerating putrescible waste is standard industry practice, ensuring the substance disperses in the receiving environment with minimal effects to water quality.	Benefits outweigh cost sacrifice.	Yes **C 6.2**
Sewage will be macerated prior to overboard discharge to increase dispersion thus reducing impact of discharge on water quality.	F: Yes CS: Minimal cost. Standard practice.	Treating and macerating sewage is standard industry practice, ensuring the substance disperses in the receiving environment with minimal effects to water quality.	Benefits outweigh cost sacrifice	Yes **C 6.3**
Professional Judgement – Eliminate				
Storage, transporting and treating/disposing onshore of sewage, greywater, putrescible and bilge wastes	F: No. Would present additional safety and hygiene hazards resulting from the storage, loading and transport of the waste material. CS: Not considered – control not feasible.	Not considered –control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Long-term transport of potable water from shore for Okha FPSO and vessels.	F: Yes. Potable water can be sourced from onshore water supplies. CS: Significant. The long-term costs and operational complexity associated with potable water bunkering outweigh the cost and negligible environmental footprint associated with offshore RO supply.	The potential environmental impact is ranked as having negligible effect; eliminating RO brine from the discharge would provide negligible environmental gain.	When considering the negligible impact from the discharge of RO brine, reliance on bunkering of potable water and incremental support vessel activities is grossly disproportionate to the environmental impact.	No
Professional Judgement – Engineered Solution				
Open hazardous drains systems integrity maintained, and oily water separator pump available to support hydrocarbon recovery from slops tank.	F: Yes CS: Minimal cost. Standard practice.	The open hazardous drain system will be maintained to support appropriate disposal of environmentally hazardous liquids	Benefit outweighs cost sacrifice	Yes **C 6.4**
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of discharge of sewage,				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
putrescible waste, greywater, bilge water, drain water, cooling water and brine. As no reasonable additional/ alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement
The impact assessment has determined that, given the adopted controls, impacts from the discharge of sewage, putrescible waste, greywater, bilge water, drain water, cooling water and brine will have localised impacts with no lasting effects. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oilfield practice/industry best practice and meet legislative requirements under Marine Orders 91, 95 and 96. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 6 Limit water quality impacts to Slight (E) from routine and non-routine wastewater discharges during the Petroleum Activities Program.	**C 6.1** Support vessels comply with Marine Orders for safe vessel operations: • Marine Order 91 (Marine pollution prevention – oil) • Marine Order 95 (Marine pollution prevention – garbage) • Marine Order 96 (Marine pollution prevention – sewage).	**PS 6.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class.	**MC 6.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Orders 91, 95 and 96).
	Refer to **C 4.1**	Refer to **PS 4.1**	Refer to **MC 4.3.1**
	C 6.2 Putrescible waste from Okha FPSO macerated prior to overboard discharge.	**PS 6.2** Putrescible wastes macerated (specified to <25 mm size) when discharged to sea.	**MC 6.2.1** Putrescible and sewage system maintenance records.
	C 6.3 Sewage system macerator maintained.	**PS 6.3** Sewage system macerator maintained as far as practicable.	
	C 6.4 Facility open hazardous drains systems integrity is maintained, and oily water separator pump is available to support hydrocarbon recovery from slops tank.	**PS 6.4** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related damage to SCEs for: • F22 – Open Hazardous Drains to: – prevent escalation of an incident following loss of containment, fire and/or explosion by removing or containing flammable liquid from hazardous areas – support appropriate containment and disposal of environmentally hazardous liquids to avoid damage to the environment. – oily water separator pump available to support hydrocarbon recovery from slops tank.	**MC 6.4.1** Records demonstrate implementation of SCE technical Performance Standard(s) and Safety Critical Element Management Procedure.

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

Context	
Process Description – Section 3.6.2 Facility Utility Systems – Section 3.6.8 Facility Operations – Section 3.6.9	Physical Environment – Section 4.4

Impact Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
FPSO and vessel fuel combustion emissions, FPSO operational flaring and fugitive emissions.	-	-	-	X	-	-	-	A	E	-	-	LCS GP PJ	Broadly acceptable	EPO 7

Description of Source of Impact

Atmospheric emissions are generated from the FPSO and support vessels during the Petroleum Activities Program. Sources include emissions from internal combustion engines (including all equipment and generators), flares, fugitives and process vents. Vessel emissions include those from internal combustion engines, fugitives and onboard incinerators. Emissions and combustion products typically include CO_2, water vapour, NO_x, SO_2, methane, refrigerant gases (including ozone-depleting substances), particulates and volatile organic compounds (VOCs).

Fuel Emissions: Internal Combustion Engines and Waste Incinerators

Consumption of fuel for power generation is the largest source of greenhouse gas emissions on the FPSO The turbines may run on fuel gas or diesel. Emergency diesel generators may also be used when required.

Diesel is used for emergency generators, cranes and backup fuel for the turbine generators. The main marine engines on the FPSO also use diesel fuel. Diesel usage on the facility (excluding support vessels) in 2018–2019 was 6,299 sm^3, the combustion of which equated to the emission 17,068 tonnes of CO_2 equivalents.

In 2018–2019, 31,674,085 Sm^3 of fuel gas was used, the combustion of which equated to the emission of 1,632,165 tonnes of CO_2 equivalents. The forecast annual emissions from fuel combustion on the FPSO was estimated using emissions factors (as per National Greenhouse and Energy Reporting Scheme [NGERS] and National Pollutant Inventory [NPI] Emission Estimation Techniques [EET]) and are presented in Table 6-14.

Incinerators may be used on vessels to dispose of flammable domestic wastes such as cardboard. Incinerators are typically used infrequently, with wastes generally segregated and transported to shore for disposal.

Table 6-15: Estimated annual emissions from fuel combustion (excluding support vessels) (based on financial year 2018–19)

Emission Type	Estimated annual emissions from fuel gas combustion (T)	Estimated annual emissions from diesel combustion (T)	Estimated total annual emissions from fuel combustion (T)
CO_2	1,628,047.97	16,995.58	59,078.70
CH_4	126.70	0.97	87.52
N_2O	3.19	0.16	2.20
Total CO_2e	1,632,165.60	17,068.53	61,923.23
NO_X	256.24	331.33	32.82

SO_X	0.41	0.11	0.00

Operational Flaring

Gas is exported from the Okha FPSO, with some gas used onboard as fuel gas. Under normal operating conditions, there is no flaring (except for nitrogen purge gas). Flaring is used to dispose excess hydrocarbons if there is a large gas release that cannot be accommodated by the recovery system, during process upsets and well start-ups. Gas flaring has the potential to increase the volumes of greenhouse gases emitted to the atmosphere.

The release of hydrocarbon gas combustion products to the atmosphere by flaring is an essential practice, primarily for safety requirements. Operational flaring is not routine and comprises non-routine, non-operational flaring that may result from activities such as:

- planned shutdowns and emergency shutdown testing
- unplanned shutdowns and emergency shutdowns, production restarts, equipment outage/failures, subsea flowline depressurisation and well remediation activities.

The flaring volume is impacted by reliability of the compression system (LP compressor and HP compressor) and the recovery system. The flash gas compressor allows a reduction in flaring volumes. During flaring, the burnt gas generates mainly water vapour and CO_2.

It is estimated that ~21,881 T of gas are flared per year (Table 6-15). Overall the flare efficiency is expected to improve.

Flaring volumes vary because of production rates and non-routine activities, outages and shutdowns. The forecast annual atmospheric emissions from flaring have been estimated using the NPI EET.

Table 6-16: Estimated annual atmospheric emissions from flaring at the Okha FPSO

Component	Flaring (T)
Flared volume (T)	21,881.00
CO_2	59,078.70
CH_4	87.52
N_2O	2.20
Total CO_2e	61,923.23
NO_X	32.82
SO_X	0.00
CO	190.36

** 2019 actual*

Non-routine Venting of Process Hydrocarbons via Flare System

During normal operations, small vents of gas from topside modules are directed to vapour recovery compressors from the relevant flare scrubber. If the gas cannot be accommodated by the recovery system, flow to that recovery system stops and is redirected to the HP and LP flare systems. These systems are maintained to effectively combust hydrocarbons as a critical component for the safe operation of the FPSO. In the unlikely event that the flares are extinguished or unavailable (such as following a major shutdown prior to system ramp-up), the hydrocarbon gas discharged via the flare system may initially not be combusted during the period required to purge the flare system and re-establish flare ignition. This may result in the short-term (minutes) low-rate release of hydrocarbon gas to the atmosphere.

Cargo Tank Inert Gas Venting

The inert gas system supplies inert gas to maintain a positive pressure in the vapour space of cargo tanks to prevent the ingress of air if there is a trip and hydrocarbon gas blanketing is not available. Hydrocarbon vapour forms in the cargo tanks as volatile hydrocarbons evaporate from the stored crude oil. This vapour is displaced from the cargo tanks as they are filled and vented to the atmosphere. Maintaining inert gas in cargo tank vapour spaces is required for the safe operation of the facility.

Fugitive Emissions

Fugitive emissions can occur from pressurised equipment are inherent in design, generally resulting from infrequent operational activities, or unintentional equipment leaks. Emissions sources can include valves, flanges, pump seals, compressor seals, relief valves, vents, sampling connections, process drains, open-ended lines, casing, tanks and other potential leakage sources from pressurised equipment.

Fugitive emissions are, by their nature, difficult to quantify. The normal approach, using the Australia National Greenhouse and Energy Reporting (Measurement) Determination 2008, as accepted by the NGERS, is to indirectly estimate the amount of emissions based on product throughput. As much of the safe operation of the FPSO relies on

the effective containment of hydrocarbons, the volumes of routine and non-routine fugitive emissions are considered small. Using these estimation techniques, the Okha FPSO reported 1516.07 tonnes of CO_2 equivalents lost through fugitive emissions in 2018–2019. Discrete, relatively small volumes of packed gases and charged systems including refrigerant gases are used across the FPSO and vessels; these have potential for small volume leaks (typically <100 kg per isolatable inventory). Such gases are used in the HVAC and refrigerant systems on the FPSO and vessels.

Impact Assessment
Facility and vessel routine and non-routine emissions, predominantly routine fuel combustion and flaring, have the potential to result in localised, temporary reduction in air quality, generation of dark smoke, and contribution to greenhouse gas emissions. Potential impacts of emissions depend on the nature of the emissions, as well as the location and nature of the receiving environment. The incineration of wastes onboard support vessels and venting from cargo tanks are considered to result in no impact to air quality. Okha FPSO design (including the rapidly dispersive characteristics of the gas turbine exhausts, flare and other emissions), the estimated level of pollutants in the emissions, and the absence of elevated background ambient levels were considered in estimating the potential for interaction with human and environmental sensitivities. The Okha facility and Operational Area is in a remote offshore location, with no expected adverse interaction with populated areas or sensitive environmental receptors associated with air emissions. There is a foraging BIA for the wedge-tailed shearwater overlapping the Operational Area; as such, wedge-tailed shearwaters may occur near the facility airshed. The nearest potential seabird roosting habitat, the Montebello Islands, are ~105 km south-south-west of the Operational Area at the closest point (distance to nearest shoreline). Given the low numbers of individuals expected potentially within the Operational Area, combined with the highly dispersed nature of air emissions from the Petroleum Activities Program, no impacts to wedge-tailed shearwaters due to air emissions are anticipated. Potential impacts are expected to be slight, short-term, localised air quality changes, limited to the airshed local to the Okha FPSO. Air emission impacts are not expected to have direct or cumulative impacts on sensitive environmental receptors. Additionally, air quality around the Okha FPSO is maintained to provide a safe working environment for operational staff. The flare and potential black smoke resulting from emissions may impact visual amenity. The offshore location of the Okha FPSO is not visible from the nearest point of the mainland (~100 km from the Operational Area at the closest point). Hence, no impacts to visual amenity for residential communities are expected. Visual amenity impairment to tourism activities are not expected.

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				
Vessel operations comply with Marine Order 97 (Marine pollution prevention – air pollution) to reduce atmospheric emissions associated with vessel operations.	F: Yes CS: Minimal cost. Standard practice	Marine Order 97 is required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class. Marine Order 97 reduces air pollution from vessels.	Control based on legislative requirements – must be adopted	Yes **C 7.1**
NGERS and NPI reporting including an estimation of greenhouse gas, energy and criteria pollutants.	F: Yes CS: Minimal cost. Standard practice	Control based on legislative requirement to provide the national reporting framework for the reporting and dissemination of information related to	Control based on legislative requirements – must be adopted	Yes **C 7.2**

15 Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
		emissions, hazardous wastes, greenhouse gas emissions, greenhouse gas projects, energy consumption and energy production to meet the objectives and desired outcomes of the legislation(s) such as: • the maintenance and improvement of air and water quality, minimisation of environmental impacts associated with hazardous wastes; and an improvement in the sustainable use of resources • act as the single framework to inform policy, meet reporting requirements, avoid duplication, and ensure that facility net greenhouse gas emissions are managed within applicable baselines.		
Good Practice				
Monitor estimate and report facility fuel and flare emissions (in accordance with NGERS/NPI) to inform optimisation management practices and minimise environmental impact of emissions.	F: Yes. Fuel and flared gas are potential product streams. As such, Woodside applies optimisation and opportunity management processes to identify and prioritise enhancement opportunities which includes improvements through energy efficiency, or reduced fuel and flare gas usage. To support this, fuel and flared gas is monitored to	Minimises environmental impact of emission through ongoing review, governance and optimisation.	Control is a WMS requirement – must be adopted.	Yes **C 7.3**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	compare against annual optimisation targets. CS: Minimal cost. Standard practice.			
Professional Judgement – Eliminate				
Eliminating flaring by venting uncombusted hydrocarbons.	F: No. Routine hydrocarbon venting is not considered good industry practice, as unburnt hydrocarbons pose potential for greater environment impact compared to combustion emissions. The ability to flare hydrocarbons is a key safety feature on the facility. Removing the ability to flare hydrocarbons may result in unacceptable safety risks on the Okha FPSO. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
None identified				
Professional Judgement – Engineered Solution				
Maintaining flare to maximise efficiency of combustion and minimise venting, incomplete combustion waste products and smoke emissions.	F: Yes. CS: Minimal cost. Standard Practice.	Flare tip integrity and ignition system functionality minimises potential for venting, incomplete combustion waste products and smoke emissions.	Control is a WMS requirement – must be adopted.	Yes **C 7.5**

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of Okha FPSO and vessel atmospheric emissions. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, atmospheric emissions from Okha FPSO and support vessel operations represent a negligible impact to receptors that is unlikely to result in a potential impact greater than slight, localised impact to air quality. The controls adopted meet the legislative requirements and Woodside's relevant Operational Standards and Procedures. The potential impacts 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 7 Limit air quality impacts to Localised (E) from Okha FPSO and vessel operations during the Petroleum Activities Program.	**C 7.1** Vessels operations compliant with Marine Order 97 (Marine pollution prevention – air pollution) to reduce atmospheric emissions associated with vessel operations.	**PS 7.1** Okha FPSO and vessels comply with Marine Order 97 as applicable to vessel size, type and class.	**MC 7.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Order 97).
	C 7.2 NGERS and NPI reporting including an estimation of greenhouse gas, energy and criteria pollutants.	**PS 7.2** Okha FPSO activity emissions reported annually in accordance with NGERS and NPI.	**MC 7.2.1** NGERs and NPI reporting records.
	C 7.3 Monitor estimate and report facility fuel and flare emissions (in accordance with NGERS/NPI) to inform optimisation management practices and minimise environmental impact of emissions.	**PS 7.3.1** Instrumentation integrity is managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE Technical Performance Standard(s) P31 – Environmental Emissions Monitoring and Controls, which: • provide means of detecting environmental releases, emissions and discharges to prevent MEEs from manifesting over time, and/or as required to assure compliance monitoring and reporting equipment.	**MC 7.3.1** Records demonstrate implementation of SCE Performance Standard(s) and Safety Critical Element Management Procedure.
		PS 7.3.2 Flare profiles tracked against optimisation targets.	**MC 7.3.2** Records demonstrate performance against annual flare profiles.
	C 7.5 Maintaining flare to maximise efficiency of combustion and minimise venting, incomplete combustion waste products and smoke emissions.	Refer to **PS 7.3.1**	Refer to **MC 7.3.1**

6.6.8 Routine Light Emissions: Light Emissions from FPSO, Vessels Operations and Operational Flaring

Context		
Process Description – Section 3.6.2 Facility Utility Systems – Section 3.6.8 Facility Operations – Section 3.6.9	Biological Environment – Section 4.5	Stakeholder Consultation – Section 5

Impact Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Light emissions from FPSO and vessels.	-	-	-	-	-	X	-	A	F	-	-	LCS GP PJ	Broadly Acceptable	N/A
Light emissions from FPSO during flaring.	-	-	-	-	-	X	-	A	F	-	-			

Description of Source of Impact

Lighting is used to allow safe operations and to communicate the presence of the FPSO and vessels to other marine users (i.e. navigation lights) and cannot reasonably be eliminated.

External lighting is located over the entire FPSO deck, as well as vessels, with most external lighting directed towards working areas such as the topsides of the FPSO, or the back deck of vessels. The top of the flare tower (the highest point of the facility) is ~98 m above sea level. External lighting on vessels is typically lower than the FPSO lights, with vessel lighting usually reduced to improve night vision of bridge crew.

The distance to the horizon at which components of the FPSO is directly visible can be estimated using this formula:

$$\text{horizon distance} = 3.57 \times \sqrt{\text{height}}$$

where 'horizon distance' is the distance to the horizon at sea level in kilometres, and 'height' is the height above sea level of the light source in metres. Using this formula, the approximate distance at which the flare tower top is visible at sea level is ~35 km from FPSO (based on flare tower height of 98 m above sea level).

During IMMR activities, underwater lighting is generated over short periods of time when ROVs are in use, as well as from deck lighting. Given the typical intensity of ROV lights and the attenuation of light in sea water, light from ROVs is localised to the vicinity of the ROV and vessels.

Impact Assessment

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: marine turtles and 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 act to override natural cues, leading to disorientation.

Potential fauna at the FPSO are predominantly pelagic fish and zooplankton, with a low abundance of transient species such as marine turtles, whale sharks, birds and large whales transiting through. There are no known critical habitats within the Operational Area for EPBC listed species, although there are three BIAs that overlap it (listed in Section 4.5.2).

Seabirds

The risk associated with collision from seabirds attracted to the light is considered to be low, given there is no critical habitat for these species within the Operational Area. There is a foraging BIA for the wedge-tailed shearwater

Impact Assessment
overlapping the Operational Area; as such, wedge-tailed shearwaters may occur within the Operational Area. The nearest potential seabird roosting habitat, the Montebello Islands, are ~105 km south-south-west of the Operational Area at the closest point (distance to the nearest shoreline). Foraging wedge-tailed shearwaters may be attracted to sources of light emission to feed upon fish drawn to the light; however, the species feeds predominantly during the day, in association with pelagic predators (Catry et al. 2009, Whittow 1997). Most foraging trips are short, with single-day foraging trips significantly more common than any other length trip, with birds returning to nesting/roosting sites between trips (Congdon et al. 2005). As such, the numbers of wedge-tailed shearwaters present in the Operational Area at night is expected to be low relative to numbers in the daylight hours, and any potential changes to behaviour would only affect a relatively low number of birds. Given the species' global distribution and primarily diurnal foraging behaviour, impacts to wedge-tailed shearwaters from artificial lighting are considered to be localised with no lasting effect. In a study of offshore oil facilities in the North Sea, Poot et al. (2008) observed that migrating seabirds can be attracted to the lights and flares of offshore oil facilities, particularly on cloudy nights and between midnight and dawn. Migratory shorebirds travelling the East Asian-Australasian Flyway may transit through the Operational Area in the vicinity of the Okha FPSO and vessels transiting to staging areas, before moving to the Australian mainland (south in the spring) or Indonesia (north in the autumn). It is possible that many migratory birds may also take advantage of ships and offshore facilities in the area to rest. The FPSO has been operational for a number of years, and in that time no large groups of birds have been observed. The environmental impact associated with seabirds attracted to the light, and hence diverted from their migratory pathway is considered to be localised with no lasting effect ***Marine Turtles – Hatchlings*** Light emissions reaching turtle nesting beaches are widely considered detrimental, owing to interference with important nocturnal activities including choice of nesting sites and orientation/navigation to the sea by post-nesting females and hatchlings (Lorne and Salmon 2007, Salmon 2003, Tuxbury and Salmon 2005). Hatchling turtles use light as a visual cue to orientate themselves towards the sea during the post-hatching dash after emerging from the nest, orientating themselves towards the relatively bright horizon above the sea and away from the relatively dark dunes (Salmon et al. 1995b, Salmon and Witherington 1995). Turtles disorientated by artificial lighting may take longer, or fail, to reach the sea, potentially resulting in increased mortality through dehydration, predation or exhaustion (Salmon and Witherington 1995). The nearest potential nesting site in relation to the Okha FPSO is the Dampier Archipelago, ~90 km from the FPSO. Lighting and the tip of the flare tower will not be visible from this potential nesting site. Given the nature of the light emitted from the Okha FPSO and vessels, and the distance to the nearest landfall (and nearest significant rookeries), artificial light from the FPSO and vessels is not expected to be directly visible to hatchling turtles; therefore, impacts to hatchling turtles emerging from nests are not credible. ***Marine Turtles – Adults*** Artificial lighting may affect the location where turtles emerge to the beach, the success of nest construction, whether nesting is abandoned, and even the seaward return of adults (Salmon et al. 1995a, 1995b, Salmon and Witherington 1995). Lighting that affects nesting adult turtles is typically from residential and industrial developments overlapping the coastline, rather than lighting offshore from nesting beaches. The Operational Area does not contain any known critical habitat for any species of marine turtle. The Goodwyn-6 suspended exploration well does overlap with the internesting BIA for flatback turtles, but artificial lighting is not installed—any lighting impacts would be limited to during IMMR activities. There is no published literature or physiological attributes of marine turtles that would suggest offshore lighting is a threat to internesting turtles (Pendoley 2017). Therefore, while it is acknowledged that marine turtles may be present in low densities in the Operational Area, impacts are expected to be localised with no lasting effect. ***Fishes*** Lighting from activities in the Operational Area may result in the localised aggregation of fish below the source of light. Note: Fish may also aggregate around the FPSO due to the habitat provided by the facility and subsea infrastructure. These aggregations of fish would be confined to a small area. Any long-term changes to fish species composition or abundance is highly unlikely.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
None Identified.				

[16] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Good Practice				
None identified.				
Professional Judgement – Eliminate				
No use of external lighting during Petroleum Activities Program.	F: No. Light management will be consistent with that required to provide a safe working environment onboard Okha FPSO and vessels. CS: Not considered – control not feasible.	Not considered – control not feasible	Not considered – control not feasible.	No
No flaring during Petroleum Activities Program	F: No. While not a routine activity, the ability to flare hydrocarbons is a safety critical requirement onboard the Okha FPSO. Note: Woodside is committed to reducing flaring, and has developed annual internal facility flare targets, against which progress is monitored. Refer to Section 6.6.7 for further information on flaring. 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. CS: Significant cost sacrifice. The retrofitting of all external lighting on Okha FPSO and all vessels would result in considerable cost and time expenditure. Considerable logistical effort to source enough inventory of the range of light types onboard Okha FPSO and vessels.	The potential environmental consequence is ranked as no lasting effect; substituting for turtle friendly lighting would provide negligible environmental gain given the location of the Okha FPSO relative to sensitive habitats. Light from the flare is the most visible source of artificial light from the facility – turtle friendly lighting has no effect on this light source.	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice for minimal environmental benefit. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Engineered Solution				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
None identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the potential impacts and risks from ongoing routine light emissions from the Okha FPSO and vessels to be ALARP in its risk state. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, in its current state, routine light emissions from the Okha FPSO and vessels represent localised impacts to marine fauna, with no lasting effect. Further opportunities to reduce the impacts have been investigated above. The potential impacts are consistent with good oilfield practice/industry best practice and are considered broadly acceptable in their current state. Therefore, Woodside considers standard operations appropriate to manage the impacts of light emissions to a level that is broadly acceptable.

6.7 Unplanned Activities (Accidents, Incidents, Emergency Situations)

6.7.1 Unplanned Hydrocarbon or Chemical Release: Hydrocarbon Release during Bunkering/Refuelling and Chemical Transfer, Storage and Use

Context		
Facility Utility Systems – Section 3.6.8 Facility Operations – Section 3.6.9 Hydrocarbon and Chemical Inventories and Selection – Section 3.9 Subsea Inspection, Monitoring, Maintenance and Repair Activities – Section 3.10	Physical Environment – Section 4.4 Biological Environment – Section 4.5	Stakeholder Consultation – Section 5

Risk Evaluation Summary

	Environmental Value Potentially Impacted							*Evaluation*						
Source of Risk	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Accidental spill of hydrocarbons to the environment during bunkering/refuelling.	-	-	X	-	-	X	-	A	D	2	M	LCS GP	Broadly acceptable	EPO 8
Accidental discharge of chemicals (including subsea control fluid) to the marine environment from storage, use or transfer.	-	-	X	-	-	X	-	A	E	4	M			

Description of Source of Risk

Diesel Bunkering/Refuelling

Diesel fuel is transferred to the FPSO by bunkering. Two key scenarios for the loss of containment of 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 diesel to the deck and/or into the marine environment. This would be <550 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 or refuelling, combined with a failure in procedure to shut off fuel pumps, for a period of up to five minutes, results in ~11 m^3 diesel loss to the deck and/or into the marine environment.

Diesel is typically not transferred to support vessels in the Operational Area; support vessels refuel in port (i.e. beyond the scope of this EP).

The primary diesel storage location onboard the FPSO and support vessels is dedicated bunker tanks within vessel hulls. Quantities of diesel stored topside are limited to day tanks (6 m^3), with all additional stored diesel located below the main deck or within the hull of the vessel (e.g. oil settling tanks, service and storage tanks and fuel tanks for equipment such as generators). Note: Equipment containing diesel may be used on deck (i.e. generators). Credible spills of diesel during use are typically small (<50 L) compared to potential releases during bunkering. Mechanisms are available to capture diesel from process/piping associated with bunkering and fuel transfers, which can be routed to the drainage system, where the spill can be contained.

Chemical Transfer, Use and Storage

Chemicals will be used during the Petroleum Activities Program for various purposes (refer to Section 3.9.2). Selection of chemicals is undertaken in accordance with the Woodside Chemical Selection and Assessment

Environment Guideline (Woodside Doc No: WM0000MG9905057). Spills of chemicals (including non-process hydrocarbons) can originate from equipment on the FPSO, support vessel decks or subsea (refer to Section 6.6.4 for an assessment of the impacts of planned chemical discharges).

Operational process chemicals on the FPSO are typically stored in dedicated vessels. The chemical stored in the largest volume on Okha is emulsion breaker, which is an operational process chemical stored in bulk (~13 m^3).

Operational non-process chemicals and maintenance chemicals present on the FPSO and support vessels are generally held in low quantities. Subsea support vessels undertaking IMMR activities may also store quantities of chemicals for subsea use. Accidental releases of small quantities of subsea chemicals from topsides may occur (e.g. deck spills). Operational experience indicates potential volumes of such spills is small (<20 L). Subsea chemical use is described in Section 3.10.1.6. Unplanned losses of subsea chemicals may occur from the subsea infrastructure. Up to 400 L/day for 5 to 22 days is the worst-case unplanned subsea control fluid release rate experienced due to a control line failure subsea.

Releases from equipment may occur from the failure of hydraulic hoses or minor leaks from process components, or spills during refuelling of equipment, which can either be located inside or outside bunded/drained areas.

ROV hydraulic fluid is supplied through hoses containing ~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 diamond wire cutters, bolt tensioning equipment, ROV tooling, etc.

Hydrocarbon Characteristics

Refer to Section 6.8.9.for a description of the characteristics of diesel, including detail on the predicted fate and weathering of a spill to the marine environment. Note: The diesel scenario considered in Section 6.8.9. is significantly larger than the volumes considered here due to bunkering and topside storage volumes.

Consequence Assessment

Diesel

Hydrocarbon spill modelling for a 105 m^3 release of diesel due to loss of marine vessel separation (MEE-07) is discussed in Section 6.8.9. The results of this modelling can be considered to be a very conservative estimate of the worst-case diesel bunkering loss of containment of 11 m^3. The results of a 105 m^3 diesel release indicate very low probabilities of contact with sensitive receptors for floating, entrained and dissolved hydrocarbons. The impact associated with a 11 m^3 diesel bunkering release are assumed to be substantially smaller than those indicated for a 105 m^3 diesel release.

Given the low viscosity of diesel, along with the high portion of volatile components, a spill of up to 11 m^3 of diesel during transfer, storage or use would spread and weather rapidly. Environmental receptors at risk would be restricted to those in the vicinity (<1 km from the release location) and may include:

- marine fauna, particularly fauna associated with the sea surface (e.g. seabirds, air-breathing vertebrates)
- plankton.

Given the relatively small worst-case credible release volume, the non-persistent nature of diesel and the low sensitivity of the receiving environment within the Operational Area (i.e. offshore open-water environment [refer to Section 4]), potential impacts are expected to be short term (<1 year) and confined to <1 km from the release location. Such impacts may include:

- localised decrease in water quality
- acute toxic effects to planktonic organisms in the immediate area of the spill.

Impacts to plankton may include acute toxicity resulting in mortality of planktonic organisms. Given the rapid turnover of plankton communities, these impacts will be short-lived (hours to days). Impacts to fish are expected to be minor and short term. Impacts to larger fauna such as cetaceans and marine turtles are expected to be light fouling, potentially resulting in irritation of sensitive membranes such as the eyes, mouth and digestive system (Helm et al. 2015). Mortality of larger fauna is not expected to occur. No impacts to ecosystem function are expected.

Minor short-term impacts may occur to other marine users (e.g. commercial fisheries); however, as the worst-case diesel spill is only 11 m^3, and there is already no fishing within the Operational Area and minimal fishing activity within 1 km of the Okha FPSO it is unlikely there would be any significant impact to commercial fishers.

As a result of this assessment, the highest potential consequence of a diesel spill from a bunkering incident has been defined as Minor and short-term and the likelihood as Unlikely (2), resulting in an overall Moderate risk following the implementation of identified controls.

Chemicals

The chemical stored in the largest volume on the Okha FPSO is an emulsion breaker, which is not planned for discharge. A maximum credible spill of emulsion breaker (or other operational chemical) is expected to mix with the offshore receiving environment, with localised decrease in water quality near the release. Potential impacts on plankton and fish in the immediate vicinity of the spill may occur with no lasting effect. No impacts to sediment quality

Consequence Assessment
are anticipated due to water depths (~75 to 130 m) and the open ocean mixing environment. Given the localised nature of impacts, distance from sensitive receptors and relatively low credible release volumes, no impacts to ecosystem function are expected from topsides releases. Accidental releases of chemicals from subsea will decrease the water quality in the immediate area of the release. Once released into a low-sensitivity receiving environment, subsea control fluids are expected to mix rapidly and dilute in the water column. There is potential for slight, localised decrease in water quality at release locations and potential impacts on marine biota. Within the mixing zone, impacts to pelagic fish are expected to be limited to avoidance of the localised area of the discharge and short-term, localised decline in planktonic organisms in the immediate vicinity of the discharge plume. Some components of subsea control fluid take longer to biodegrade. These components make up ~0.35% of the total volume. Therefore, for a release at 400 L/day, ~1.3 L may be present in the sediment after 28 days. This would be distributed over the area of the release. Given the frequency and volumes of releases, impacts to sediments are likely to be highly localised. Sediments in the Operational Area are expected to be broadly consistent with those in the NWS Province, as described in Section 4.4.4, with filter feeders such as sponges, ascidians, soft corals and gorgonians associated with areas hard substrate. The only areas of hard substrate expected in the vicinity are artificial habitat associated with subsea infrastructure. Subsea control fluid does not contain any components that are both bioaccumulative and non-biodegradable, therefore chronic effects to ecosystems are not expected due to the localised nature of discharge plumes and potential for sediment quality impacts. As a result of this assessment, the highest potential consequence of an accidental discharge of chemicals to the marine environment has been defined as Slight and short-term and the likelihood as Likely (4), resulting in an overall Moderate risk following the implementation of identified controls.

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				
Support vessels compliant with Marine Order 91 (Marine pollution prevention – oil) for safe vessel operations.	F: Yes. CS: Minimal cost. Standard practice.	Marine Order 91 is required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class. Compliance with Marine Order 91 reduces the risk of accidental hydrocarbon release during transfer	Control based on legislative requirement – must be adopted.	Yes **C 8.1**
Good Practice				
Chemical Selection and Assessment Environment Guideline: • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected, no further control required.	F: Yes. Woodside routinely implements a chemical selection process at the Okha FPSO, which is based on OCNS. CS: Minimal. The OCNS is widely used throughout the industry, and chemical suppliers	Selection and assessment of chemicals in accordance with the Woodside process reduces environmental impacts associated with planned chemical discharge.	Woodside's chemical selection process is used to ensure fluids discharged meet Woodside's chemical environmental risk assessment standards while still providing the required technical capability.	Yes **C 4.1**

[17] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[17]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
• If chemicals with a different OCNS rating, sub warning or non–OCNS-rated chemicals are required, chemicals are assessed in accordance with the procedure prior to use.	are aware of the requirements of the scheme.		Benefits outweigh cost sacrifice.	
Limit volume of subsea control fluid discharged to the marine environment through monitoring subsea control fluid use, investigating material discrepancies, and using subsea control fluid with dye marker to help identify potential integrity failures.	F: Yes. The use of subsea control fluid is monitored to maintain adequate fluid in the system. CS: Minimal cost.	Limits the volumes of subsea control fluid discharge to the marine environment.	Benefit outweighs cost sacrifice.	Yes **C 4.3**
Increased inspection of the subsea system to prevent unplanned discharges of subsea control fluid.	F: Yes. Inspection frequency is currently risk based. CS: Cost and duration of full field inspection.	Minimal benefit as failures are typically catastrophic. Most effective means to identify unplanned releases is via consumption monitoring (in place)	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice and provides minimal environmental benefit. The cost/sacrifice outweighs the benefit gained.	No
Diesel bunkering hoses will • have dry break couplings • be pressure-rated at purchase to reduce the risk of accidental hydrocarbon release during bunkering.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a hose failure.	Benefits outweigh cost sacrifice	Yes **C 8.2**
Implementation of bunkering procedures to reduce the risk of a hydrocarbon release as a result of a bunkering incident.	F: Yes. CS: Minimal cost. Standard practice.	Implements a procedure to outline the methods and requirements for undertaking safe bunkering. This reduces the likelihood of a bunkering incident.	Benefits outweigh cost sacrifice	Yes **C 8.3**
Safely storing chemicals and diesel to prevent the release to the marine environment.	F: Yes. CS: Minimal cost. Standard practice.	Reduces risk of unplanned chemical/diesel release.	Benefits outweigh cost sacrifice.	Yes **C 8.4**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[17]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Incident reports are raised for unplanned releases within event reporting system.	F: Yes. CS: Minimal cost. Standard practice.	Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Control based on Woodside standard and regulatory requirements.	Yes **C 8.5**
Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.			
Professional Judgement – Eliminate				
None identified.				
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
FPSO drainage system in place to contain and dispose leaks and spills of hazardous liquids, to avoid harm to the environment.	F: Yes. The FPSO has been designed with an integral drains system that can be used to contain liquid spills in hazardous and non-hazardous areas. CS: Minimal. Inherent feature of FPSO design.	The drains system can be used to contain a spill before it reaches the environment.	Benefit outweighs cost sacrifice.	Yes **C 8.6**
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of accidental spills of hydrocarbons or chemicals from bunkering/refuelling, storage, use and transfer. As no reasonable additional/alternative controls were identified that would further reduce the consequences and risks without grossly disproportionate sacrifice, the risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The consequence assessment has determined that, given the adopted controls, accidental spills during bunkering/refuelling, or spills from storage, transfer and use represent a moderate risk rating that is unlikely to result in a consequence greater than minor, short-term impacts. Further opportunities to reduce the risks have been investigated above. The adopted controls are considered good oilfield practice/industry best practice and meet requirements of Australian Marine Orders. The potential risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks of bunkering/refuelling, and storage, transfer and use to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 8 Environmental risk posed by hydrocarbon or chemical spills limited to Moderate during bunkering, refuelling and chemical transfer, storage and use during the Petroleum Activities Program.	**C 8.1** Support vessels compliant with Marine Order 91 (Marine pollution prevention – oil) for safe vessel operations.	**PS 8.1** Support vessel practices comply with Marine Orders as applicable to vessel size, type and class (Marine Order 91).	**MC 8.1** Marine verification records demonstrate compliance with Marine Order 91.
	C 4.1 Refer to Section 6.6.4	**PS 4.1** Refer to Section 6.6.4.	**MC 4.1.1** Refer to Section 6.6.4.
	C 4.3 Refer to Section 6.6.4.	**PS 4.3** Refer to Section 6.6.4.	**MC 4.3.1** Refer to Section 6.6.4.
	C 8.2 Diesel bunkering hoses will: • have dry break couplings • be pressure-rated at purchase to reduce the risk of accidental hydrocarbon release during bunkering.	**PS 8.2** Diesel transfer hoses to have dry break couplings and pressure rating suitable for intended use.	**MC 8.2.1** Records demonstrate diesel transfer hoses are fitted with dry break couplings and are pressure-rated.
	C 8.3 Implementation of bunkering procedures to reduce the risk of a hydrocarbon release as a result of a bunkering incident.	**PS 8.3.1** Implement Diesel Fuel System – Loading Bunkers – Standard Operating Procedure (Woodside Doc No. EH0000MG0137.5001). Key requirements include: • Routine bunkering to be carried out when adequate lighting is available for spill detection unless following an activity-specific risk assessment approved by the Offshore Installation Manager (OIM). • Communications between the supply vessel and facility bunker station will be maintained during bunkering. • Hoses and connections to be visually checked during refuelling. • Tank levels will be monitored throughout bunkering. • Spill clean-up equipment will be available near the bunker station. • Bunkering hose inventory will be drained to the supply vessel before disconnection.	**MC 8.3a** Records demonstrate bunkering undertaken in accordance with facility and contractor bunkering procedures.
		PS 8.3.2 Vessels will have in place their own bunkering plans and checklists depending on the	**MC 8.3b** Marine verification records demonstrate vessel-specific bunkering plans

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		specifications of both the supplying and receiving vessel.	available and applied during bunkering operations.
	C 8.4 Chemicals will be stored safely to prevent the release to the marine environment.	**PS 8.4** Chemical/diesel storage areas for transportable containers on the FPSO will have adequate containment in place to contain an accidental chemical/diesel spill.	**MC 8.4** FPSO chemical/diesel storage areas for transportable containers provided with adequate bunding/containment.
	C 8.5 Incident reports are raised for unplanned releases within event reporting system.	**PS 8.5** • incident reports raised for unplanned releases • recordable incidents notified for unplanned liquid releases to sea of: – 80 L or more of hydrocarbons; or – 1000 L or more of environmentally hazardous chemical in any 48-hour period.	**MC 8.5** Records demonstrate incident reports raised for unplanned releases, and applicable recordable incident notifications completed.
	C8.6 Okha FPSO drainage system in place to contain and dispose leaks and spills of hazardous liquids.	**PS 8.6** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related damage to SCEs for: • F22 – Hazardous Open Drains and F23 – Non-hazardous Open Drains to together: – prevent escalation of an incident following loss of containment, fire and/or explosion by removing or containing flammable liquid from hazardous areas – support appropriate containment and disposal of environmentally hazardous liquids to avoid damage to the environment.	**MC 8.6**Records demonstrate implementation of SCE Performance Standard(s) and Safety Critical Element Management Procedure (F22 and F23).
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.7.2 Unplanned Discharges: Hazardous and Non-hazardous Waste Management

Context	
Operational Details – Section 3.6	Physical Environment – Section 4.4 Biological Environment – Section 4.5

Risk Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Incorrect disposal or accidental discharge of non-hazardous and hazardous waste to the marine environment.	-	X	X	-	-	X	-	A	E	2	M	LCS GP PJ	Broadly Acceptable	EPO 9

Description of Source of Risk

Non-hazardous and Hazardous Waste

Normal operations on the FPSO and support vessels result in various hazardous and non-hazardous wastes. These materials could potentially impact the marine environment if incorrectly disposed or discharged in significant quantities.

Non-hazardous wastes include domestic and industrial wastes, such as aluminium cans, bottles, paper and cardboard and scrap steel. Hazardous wastes include recovered solvents, excess or spent chemicals, oil-contaminated materials (e.g. sorbents, filters and rags), batteries and potentially material containing naturally occurring radioactive materials (NORMs). Monitoring is conducted to identify and manage waste containing NORMs in hydrocarbon-containing infrastructure. Sand and sludges may also be periodically generated during well clean-up operations, desanding and vessel maintenance. Waste materials generated on the FPSO (including hazardous wastes) are transported to shore for disposal or recycling by a licensed waste contractor unless approved for discharge to the environment.

Consequence Assessment

Non-hazardous and Hazardous Waste

The potential impacts of non-hazardous and hazardous wastes accidentally discharged to the marine environment include direct pollution and contamination of the marine environment, potentially resulting in slight localised decreased water or sediment quality. Secondary impacts due to potential contact with individual marine fauna include entanglement or ingestion, which may lead to injury and/or death of individual animals.

Based on the nature and scale of activities that may generate wastes, the location of the Operational Area, the types, size and frequency of wastes that could occur, and species present, the highest potential consequence for the temporary or permanent loss of hazardous or non-hazardous waste materials into the marine environment has been defined as Slight with short-term impacts, and the likelihood as Unlikely (2), resulting in an overall Moderate risk following the implementation of identified controls.

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				
Support vessels compliant with Marine Orders for safe vessel operations: • Marine Order 94 (Marine pollution prevention – packaged harmful substances) • Marine Order 95 (Marine pollution prevention – garbage).	F: Yes CS: Minimal cost. Standard practice.	Implementation of Marine Orders 94 and 95 reduces the likelihood of a harmful substance being released to the environment. Implementation is standard practice for commercial vessels as applicable to vessel size, type and class.	Controls based on legislative requirements – must be adopted.	Yes **C 9.1**
Good Practice				
Storage, handling and transport of wastes in accordance with the Waste Management Plan for Offshore Facilities.	F: Yes CS: Minimal cost. Standard practice.	Reduces the likelihood of a release of waste to the environment by providing guidance on storage, handling and transport of wastes.	Benefit outweighs cost sacrifice.	Yes **C 9.2**
If safe and practicable to do so, vessel, ROV or crane will be used to attempt recovery of material[19] environmentally hazardous or non-hazardous solid object/waste lost overboard.	F: Yes CS: Minimal cost. Standard practice.	Potentially reduces consequence by recovering object/waste container from the environment.	Benefit outweighs cost sacrifice	Yes **C 9.3**
Incident reports are raised for unplanned releases within event reporting system.	F: Yes CS: Minimal cost. Standard practice.	Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Control based on Woodside standard and regulatory requirements.	Yes **C 8.4**
Professional Judgement – Eliminate				
None identified.				
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
None identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of accidental discharge of non-hazardous and hazardous wastes. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

[18] Qualitative measure

[19] For this control/performance standard, 'material' is defined as unplanned releases of environmentally hazardous or non-hazardous solid object/waste events with an environmental concequence of >F.

Demonstration of Acceptability
Acceptability Statement The consequence assessment has determined that, given the adopted controls, the accidental discharge of non-hazardous waste and hazardous waste represent a Moderate risk rating, and no lasting impacts to water quality, marine sediments and marine species are expected. These potential impacts are considered to have no lasting effect and are not considered to be significant. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oilfield practice/industry best practice and meet relevant Commonwealth and State regulatory requirements. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of accidental discharge of non-hazardous and hazardous waste to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 9 Environmental risk from hazardous and non-hazardous waste management limited to Moderate during the Petroleum Activities Program.	**C 9.1** Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Order 94 (Marine pollution prevention – packaged harmful substances) • Marine Order 95 (Marine pollution prevention – garbage).	**PS 9.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class.	**MC 9.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Orders 94 and 95).
	C 9.2 Implementation of Waste Management Plan for Offshore Facilities (W8000AH001).	**PS 9.2** Implementation of Waste Management Plan for Offshore Facilities (W8000AH001), including: • waste segregation and storage • records of all waste to be disposed, treated or recycled shall be maintained; records shall include (though are not limited to) quantity of waste, waste type and disposal/recycle location • waste streams shall be appropriately handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) shall be transported and disposed of onshore.	**MC 9.2** Records demonstrate implementation of Waste Management Plan for Offshore Facilities (W8000AH001).
	C 9.4 If safe and practicable to do so, vessel, ROV or crane will be used to attempt recovery of	**PS 9.3** Material environmentally hazardous or non-hazardous solid waste object/container dropped to the marine environment will be recovered	**MC 9.3** Records detail the recovery attempt consideration and status of material environmentally hazardous or nonhazardous solid

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	material[20] environmentally hazardous or non-hazardous solid object/waste lost overboard.	where safe and practicable to do so, considering: • 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, ROV availability and suitable weather).	waste object/container lost to the marine environment.
	C 8.5 Refer to Section 6.7.1.	**PS 8.5** Refer to Section 6.7.1.	**MC 8.4** Refer to Section 6.7.1.

6.7.3 Physical Presence: Interactions with Marine Fauna

Context	
Facility Operations – Section 3.6.9	Species – Section 4.5.2

Risk Evaluation Summary														
Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Physical presence of vessels resulting in collision with marine fauna.	-	-	-	-	-	X	-	A	E	1	L	LCS GP PJ	Broadly Acceptable	EPO 10

Description of Source of Risk
The vessels operating in and around the Operational Area have the potential in interact with 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 potential frequency and severity of impacts due to collisions vary due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth), and the type of marine fauna potentially present and their behaviours.

[20] For this control/performance standard, 'material' is defined as unplanned releases of environmentally hazardous or non-hazardous solid object/waste events with an environmental concequence of >F.

Consequence Assessment
The likelihood of vessel–whale collision being lethal is influenced by vessel speed; the greater the speed at impact, the greater the risk of mortality (Jensen and Silber 2004, List et al. 2001). Vanderlande and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from ~20% at 8.6 knots to ~80% at 15 knots. According to the data of Vanderlin and Taggart (2007), it is estimated that the risk is <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, there are only two known instances of collisions when the vessel was travelling at <6 knots. Both of these were from whale-watching vessels that were deliberately placed among whales (Jensen and Silber 2004). Vessels undertaking activities within the Operational Area are likely to be travelling <8 knots; much of the time vessels are holding stationary. Therefore, the risk of a vessel collision with protected species resulting in death is inherently low. The Operational Area occurs near but does not overlap the humpback whale and pygmy blue whale migration BIAs (Section 4.5.2.5). Humpback whales may be abundant near the Operational Area during their seasonal migration period but are unlikely to traverse it. Analysis of underwater noise logger data indicated pygmy blue whales are present in waters off North West Cape between October to December (northbound migration) and April to August (southbound migration) (McCauley and Jenner 2010). Satellite tagging studies have shown pygmy blue whales migrating along the WA coast in water depths between 200 m and 1000 m, which does not include the depth range of the Operational Area (~75 to 130 m). Given the lack of overlap between the humpback whale and pygmy blue whale migration BIAs, and the consequent low likelihood of either species traversing the Operational Area, harmful interactions between vessels and whales during the activity are considered unlikely. Given the typical speeds of vessels within the Operational Area, the unlikely event of a collision between vessels and whales is not expected to result in mortality. Whale sharks are at risk from vessel strikes when feeding at the surface, or in shallow waters where there is limited opportunity to dive. Whale sharks may traverse offshore waters, including in the Operational Area, during their migrations to and from Ningaloo Reef, and 0.08% of the BIA for foraging whale sharks overlaps the Operational Area. Due to the small proportion of the foraging BIA overlapped by the Operational Area impacts to whale sharks are not expected, and their presence within the operational area would be transitory and of a short duration. There are no constraints (e.g. shallow water, shorelines) preventing whale sharks from moving away from vessels. The internesting buffer for flatback turtles BIA overlaps the Operational Area at the Goodwyn-6 suspended exploration well. During internesting turtles remain close to the nesting beach or rookery (DoEE 2017). Typically, internesting habitat is located immediately seaward of designated nesting habitat (DoEE 2017). Part of the Operational Area overlaps the flatback turtle 60 km internesting buffer zone (October–March); however, given the Operational Area is >70 km from the nearest nesting beach, internesting turtles are not anticipated to remain in the Operational Area for prolonged periods of time or in large numbers. The typical response from turtles on the surface to the presence of vessels is to dive (a potential ‘startle’ response), which decreases the risk of collisions (Hazel et al. 2007). As with cetaceans, the risk of collisions between turtles and vessels increases with vessel speed (Hazel et al. 2007). It is not deemed credible that vessel movement associated with the Petroleum Activities Program could have a significant impact on marine fauna populations given (1) the low presence of transiting individuals, (2) avoidance behaviour commonly displayed by whales, whale sharks and turtles, and (3) low operating speed of the activity support vessels in the Operational Areas (generally <8 knots or stationary, unless operating in an emergency). Activities are considered highly unlikely to result in a consequence greater than slight, short-term disruption to individuals or a small proportion of the population and no impact on critical habitat or fauna activity.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[21]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans will be implemented to reduce the likelihood of collision with whales and dolphins.	F: Yes CS: Minimal cost. Standard practice.	Reductions in speed around protected fauna reduce the likelihood of collision.	Controls based on legislative requirements – must be adopted.	Yes **C 10.1**
Good Practice				

[21] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[21]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Extend application of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans to turtles and whale sharks.	F: Potentially, however turtles and whale sharks are hard to detect at sea (Operational Area water depth is ~75–130 m). Whale sharks and turtles may be more difficult to detect than whales, due to their size (turtles) and the absence of clearly visible surface behaviour (e.g. blows). Additionally, turtles typically dive in response to disturbance, therefore would not always be feasible to implement. CS: Minimal cost.	Given the expected low numbers of turtles and whale sharks within the Operational Area, interactions between vessels and turtles/whale sharks are considered to be highly unlikely, therefore adopting the control would provide low benefit.	Disproportionate. Interactions between vessels and turtles/whale sharks are considered to be highly unlikely, therefore adopting the control would provide low benefit given its low effectiveness.	No
Professional Judgement – Eliminate				
Do not use vessels.	F: No. No alternative to the use of vessels during the Petroleum Activities Program was identified. As vessels must be used to undertake the Petroleum Activities Program, there is no feasible means to eliminate the source of risk. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
None identified.				

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the risk of vessel collision with marine fauna. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The risk assessment has determined that, given the adopted controls, vessel collision with marine fauna represents a Low risk rating that is expected to result in no lasting effect to fauna populations 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 oilfield practice/industry best practice and meet the requirements of Part 8 (Division 8.1) of the EPBC Regulations 2000. 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 10 No mortality of cetaceans resulting from interactions with support vessels or FPSO.	**C 10.1** EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, which includes these measures[22]: • Vessels will not travel >6 knots within 300 m of a cetacean (caution zone) and not approach closer than 100 m from a whale. • Vessels will not approach closer than 100 m from a whale (with the exception of animals' bow riding). • If the cetacean shows signs of being disturbed, activity support vessels will immediately withdraw from the caution zone at a constant speed of <6 knots.	**PS 10.1** Vessels will comply with the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans to manage the risk of fauna collision.	**MC 10.1.1** Records demonstrate no breaches with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans and Woodside Marine Charterers Instructions. **MC 10.1.2** Records demonstrate reporting cetacean ship strike incidents to the National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike).

[22] For safety reasons, the specified distance requirements are not applied for a vessel holding station or with limited manoeuvrability e.g. loading, backloading, offloading, close standby cover for overside working and emergency situations.

6.7.4 Physical Presence: Introduction of IMS

Context		
Facility Operations – Section 3.6.9	Biological Environment – Section 4.5	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
IMS in vessel ballast tanks or on vessels/submersible equipment.	-	-	-	-	X	X	X	A	E	1	L	LCS GP PJ	Broadly Acceptable	EPO 11

Description of Source of Risk

Vessels are potential vectors for the introduction of IMS to the Operational Area during the Petroleum Activities Program; these include:

- facility support vessels: typically sourced from Australian waters and generally considered to be low risk, these vessels are the most commonly used vessels in the Operational Area.
- offtake tankers: typically, from international waters and generally considered to be low risk, these tankers may visit the Operational Area approximately every three weeks, with offtake frequency declining as production rates decline; offtake operations take ~36 hours to complete.
- subsea support vessels: may be sourced from Australia or overseas, depending on requirements and vessel availability.

The Okha FPSO may leave the Operational Area to avoid dangerous weather and/or undergo modifications and repairs. This may include spending short periods of time in areas that are considered high risk for the presence of potential IMS, such as ports beyond Australian waters.

IMS may be introduced to the Operational Area through:

- ballast water discharge
- release of IMS propagules/fragments from biofouling.

Potential IMS can be drawn into ballast tanks when ballast water is taken on as cargo is unloaded or to balance vessels under load. Offtake tankers use ballast water to maintain vessel stability. This ballast is discharged when loading crude oil from the FPSO during offtake operations.

The FPSO may require ballast water to operate safely when detached from the RTM. Ballast water taken on within the Operational Area (i.e. prior to detachment) is considered unlikely to host IMS due to the offshore location and deep water (~75 to 130 m water depth). When returning from beyond Australian waters, the FPSO routinely undertakes ballast water exchanges to achieve low-risk ballast water. Ballast water exchanges are not typically required by support or subsea vessels. All support and subsea vessels are required to have low-risk ballast water onboard prior to being contracted.

All vessels are inherently subject to some level of marine fouling. Organisms attach to the vessel hull, particularly in areas where they can find a good surface (e.g. seams, strainers and unpainted surfaces) or where turbulence is lowest (e.g. niches, sea chests). Biofouling organisms can become established in an area by releasing propagules (e.g. eggs, larvae), or by attaching to substrate after becoming detached from the host vessel.

Non-indigenous marine species (NIMS) are organisms that have been introduced into a region outside their natural biogeographic range and have the ability to survive, reproduce and establish founder populations. Not all NIMS introduced into an area will thrive or cause demonstrable impacts. Most NIMS around the world are relatively benign and few have spread widely beyond sheltered ports and harbours. Only a subset of NIMS that become abundant and impact on social/cultural, human health, economic and/or environmental values can be considered IMS.

Consequence Assessment
IMS have historically been introduced and translocated around Australia by various human means including biofouling and ballast water. Species of concern are those that: • are not native to the region • are likely to survive and establish in the region • are able to spread by human-mediated or natural means. Species of concern vary from one region to another, depending on environmental factors such as water temperature, salinity, nutrient levels and habitat type. These factors dictate their survival and invasive capabilities. Introducing IMS into the local marine environment may alter the ecosystem, as IMS have characteristics that make them superior (in a survival and/or reproductive sense) to indigenous species. They may prey upon local species that had previously not been subject to this kind of predation and therefore not have evolved protective measures against the attack; they may outcompete indigenous species for food, space or light; and can also interbreed with local species, creating hybrids such that the endemic species is lost. IMS have also proven economically damaging to areas where they have been introduced and established. Such impacts include direct damage to assets (fouling of vessel hulls and infrastructure) and depletion of commercially harvested marine life (e.g. shellfish stocks). IMS have proven particularly difficult to eradicate from areas, once established. If the introduction is captured early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life. Despite the potential high consequence of the establishment of a marine pest within a high-value environment, like coastal or sheltered nearshore waters, the deep offshore open waters of the Operational Area are not conducive to the settlement and establishment of IMS (Geiling 2016), due to the lack of light or suitable habitat to sustain growth or survival. The Okha FPSO facility is located on the NWS, ~37 km west of Glomar Shoal in waters ~75–130 m deep. Most vessels used during the Petroleum Activities Program are typically sourced from Australia and are not considered high risk for IMS introduction. Given this, the likelihood of introducing/acquiring IMS during the Petroleum Activities Program is considered highly unlikely and considered manageable given the ballast water and biofouling controls that will be implemented.

Summary of Potential Impacts to Environment Value(s)

In support of Woodside's assessment of the impacts and risks of IMS introduction associated with the Petroleum Activities Program, Woodside conducted a risk and impact evaluation of the different aspects of marine pest translocation associated with the activity. The results of this assessment are presented in the table below.

As a result of this assessment, Woodside has presented the highest potential consequence as Slight and short-term and the likelihood as Highly Unlikely (1), resulting in an overall Low risk following the implementation of identified controls.

IMS Introduction Aspect	Credibility of Introduction	Consequence of Introduction	Likelihood
Transfer of IMS from infected vessel to Operational Area, and establishment on the sea floor or subsea infrastructure.	**Not Credible** The deep offshore open waters of the Operational Area, away from shorelines and/or critical habitat, more than 58 nm from shore and in waters 75–130 m deep, are not conducive to settling and establishing IMS.		
Transfer of IMS from infected vessel to and subsequent establishment on the Okha FPSO.	**Credible** There is potential for the transfer of marine pests to occur.	Slight (E) – Environment Minor (D) – Reputation and Brand If IMS were to establish, this would potentially result in fouling of intakes (depending on the pest introduced), and likely result in the quarantine of the Okha FPSO until eradication could occur	Highly Unlikely (1) Interactions between the Okha FPSO and support vessels will be limited during the Petroleum Activities Program, with a 500 m PSZ being adhered to. Offtake tankers are considered to present a low IMS risk, do not directly contact the Okha FPSO and are within the

Consequence Assessment			
		(through cleaning and treatment of infected areas). This would be costly to undertake. Such introduction would be expected to have Minor (D) impact to Woodside's reputation and brand. Environmental consequence of introduction of IMS to the Okha FPSO is considered Slight Australia, localised, and would relate to habitat directly on the Okha FPSO.	Operational Area for short periods of time (typically <36 hours). Spread of marine pests via ballast water or spawning in these open ocean environments is considered Highly Unlikely (1).
Transfer of IMS when Okha FPSO is disconnected and returns to Operational Area from shipyard.	**Credible** There is potential for the transfer of marine pests to occur.	Slight Australia – Environment Minor (D) – Reputation and Brand If IMS were to return on the FPSO and establish, this would potentially result in fouling of intakes (depending on the pest introduced), and likely result in the quarantine of the Okha FPSO until eradication could occur (through cleaning and treatment of infected areas). This would be costly to undertake. Such introduction would be expected to have Minor (D) impact to Woodside's reputation and brand. Environmental consequence of introduction of IMS to the Okha FPSO is considered Slight Australia, localised, and would relate to habitat directly on the Okha FPSO.	Highly Unlikely (1) Interactions between the Okha FPSO and support vessels will be limited during the Petroleum Activities Program, with a 500 m PSZ being adhered to. In addition, controls will be implemented (refer to ALARP discussion below) on return of Okha FPSO from Singapore to limit likelihood of IMS translocation. Spread of marine pests via ballast water or spawning in these open ocean environments is considered Highly Unlikely (1).
Transfer of IMS from infected vessel to a subsequent establishment on Okha FPSO, then transfer of IMS to a secondary vessel from the Okha FPSO.	**Not Credible** Risk is considered so remote that it is not credible for the purposes of the Petroleum Activities Program. The transfer of a marine pest from an infected activity vessel to the Okha FPSO was already considered highly unlikely, given the offshore open ocean environment. For a marine pest to then establish into a mature spawning population on the Okha FPSO and then transfer to another support		

Consequence Assessment			
	vessel is not considered credible (i.e. beyond the Woodside risk matrix). The Okha FPSO is in an offshore, open ocean, deep environment. Support vessels only spend short periods of time alongside the Okha FPSO (i.e. during backloading or bunkering activities). There is also no direct contact (i.e. they are not tied up alongside) during these activities. Note: Woodside has conducted marine vessel movements between the Okha FPSO and WA ports (such as Dampier) for a long time, and no IMS has been detected in these ports (DoF 2017).		

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
All vessels will undertake ballast water exchange or treat ballast water using an approved ballast water treatment method/system.	F: Yes CS: Minimal cost. Standard practice.	Reduction in the likelihood that ballast water will host IMS.	Controls based on legislative requirements under the Commonwealth *Biosecurity Act 2015* – must be adopted.	Yes **C 12.1**
Good Practice				
Woodside's IMS risk assessment process [23] will be applied to vessels undertaking the Petroleum Activities Program. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk (such as the treatment	F: Yes. CS: Minimal cost. Good practice implemented across all Woodside Operations.	Reduction in the likelihood that a vessel will host IMS.	Benefits outweigh cost/sacrifice.	Yes **C 11.2**

[23] The correct management of IMS requires careful consideration of multiple complex factors. These range from an understanding of the vectors through which IMS can be introduced and spread, the maintenance and operational history of vessels proposed to be used, climatic conditions, existing baseline data of past and proposed transit and operational area, and consideration of different regulatory frameworks. Woodside's approach simplifies the management of IMS into a standardised toolkit that includes an IMS management plan, lists of 'species of concern', risk assessment score sheets, inspection procedures and a Contractor Information Pack to ensure the risk is managed in a simple and efficient manner. Woodside's risk-based process also delivers continued value to Woodside by reducing the risk of delays and increased operational costs, while delivering excellent marine biosecurity and environmental outcomes. Woodside's approach has been validated through a proactive program that engaged stakeholders during development of the methodology. This included Woodside personnel, scientific input and review by experienced external IMS consultants, recognised industry experts and liaison with regulatory agencies and vessel contractors. The result is a fit-for-purpose biofouling management process that is now embedded within Woodside's marine systems, procedures and contractual requirements.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.				
Monitor the Okha FPSO facility for IMS.	F: Yes. Implementation of a survey is considered feasible for the Okha facility. CS: Significant. IMS inspection of in-water assets typically requires diver-based inspections to reliably detect IMS. This is a costly, time-consuming process that introduces a significant safety risk. Monetary cost of IMS survey for Okha facility sized infrastructure would be ~$500,000 AUD (based on historical surveys of FPSOs by Woodside) and costs of ROV to support survey.	Potential for reduction of consequence. If detected, IMS can be managed.	Disproportionate. Interactions between Okha facility and support/subsea vessels will be limited, and the vessels involved will have been managed through the implementation of Woodside's IMS Management Plan (IMSMP) (**C 11.2**) a verified process which provides Woodside confidence in the verification of EPO 12. Consequently, any additional benefit gained by implementing this control is considered disproportionate, given the controls already adopted (and noting already-incurred cost through implementation of the IMSMP [i.e. inspections and cleaning where risk warrants]) and the unlikely likelihood of a translocation event.	No
Professional Judgement – Eliminate				
Do not use vessels.	F: No. No alternative to the use of vessels during the Petroleum Activities Program was identified. As vessels must be used to undertake the Petroleum Activities Program, there is no feasible means to eliminate the source of risk.	Not assessed, control not feasible.	Not assessed, control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Not assessed, control not feasible.			
Professional Judgement – Substitute				
Source vessels based in Australia only.	F: Yes. Support vessels are routinely sourced from Australia. However, depending on the nature of subsea IMMR activities, there may not be a suitable subsea support vessel within Australian waters. CS: Potential for significant cost and schedule impacts.	Reduction in the likelihood that a vessel will host IMS.	Disproportionate. The cost/sacrifice is grossly disproportionate to the benefit gained.	No
IMS inspection of all vessels.	F: Yes. Approach to inspect vessels is feasible. CS: Significant cost and schedule impacts. Thorough inspections require vessels to be removed from the sea (e.g. slipped or dry docked) and examined by an IMS expert. This process incurs significant financial and schedule sacrifices.	Reduction in the likelihood that a vessel will host IMS.	Disproportionate. The cost/sacrifice is grossly disproportionate to the benefit gained. Interactions between FPSO and support/subsea vessels will be limited, and the vessels involved will have been managed through the implementation of Woodside's IMSMP (**C 11.2**).	No
Inspection of Okha FPSO by IMS inspector prior to return from international sailaway.	F: Yes. Approach to inspect vessels is feasible. CS: Significant cost and schedule impacts. Thorough inspections require vessels to be removed from the sea (e.g. slipped or dry docked) and examined by an IMS inspector. This process incurs significant financial and schedule sacrifices.	Reduction in the likelihood that the FPSO would host IMS on return to Operational Area from international sailaway.	Although the inspection of all vessels associated with Okha FPSO operations is considered disproportionate (see the rejected control above), considering the implementation of Woodside's IMSMP (**C 11.2**), the inspection of only the Okha FPSO by an IMS inspector is considered appropriate given the added level of confidence it provides.	Yes **C 11.3**
Professional Judgement – Engineered Solution				
None identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***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 IMS introduction and establishment. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The risk assessment has determined that, given the adopted controls, introduction of IMS represent a low risk rating that is highly unlikely to result in an environmental consequence greater than slight impact on marine communities within the Operational Area. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oilfield practice/industry best practice and meet Australian legislative requirements, including the Commonwealth *Biosecurity Act 2015*. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of IMS to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 11 No introduction of IMS into the Operational Area as a result of the Petroleum Activities Program.	**C 11.1** Vessels will undertake ballast water exchange or treat ballast water using an approved ballast water treatment method/system.	**PS 11.1** Compliance with Australian Ballast Water Management Requirements (as defined under the Commonwealth *Biosecurity Act 2015*) (aligned with the International Convention for the Control and Management of Ships' Ballast Water and Sediments) to prevent the introduction of IMS.	**MC 11.1** Ballast water exchange records maintained by vessels which verify compliance against Ballast Water Management requirements.
	C 11.2 Woodside's IMS risk assessment process is applied to vessels undertaking the Petroleum Activities Program. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.	**PS 11.2** Compliance with Woodside's IMSMP to minimise the risk of introducing IMS.	**MC 11.2.1** Records of IMS vessel risk assessments maintained for vessels, as required by the IMSMP.
			MC 11.2.2 Records maintained of management measures that have been implemented where identified through the IMS vessel risk assessment process.
	C 11.3 Inspection of Okha FPSO by IMS Inspector prior to return from international sailaway.	**PS 11.3** FPSO will be inspected by a trained IMS inspector prior to return from international sailaway and any additional management measures identified to reduce the	**MC 11.3** Records of IMS inspection of FPSO maintained.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		translocation risk of IMS implemented.	

6.8 Unplanned Activities (Accidents, Incidents, Emergency Situations) – Major Environmental Events

The risks considered in this section have been identified as MEEs due to the potential for significant consequence. These sources of risk are subject to additional consideration in accordance with the process described in Section 2.7.

All MEEs presented are as a result of hydrocarbon loss of containment to the marine environment and atmosphere. The risk assessments have been informed using quantitative hydrocarbon spill modelling. An overview of the MEEs is provided in Section 6.8.2.

6.8.1 Quantitative Spill Risk Assessment Methodology

Quantitative hydrocarbon spill modelling was undertaken by RPS APASA, on behalf of Woodside, using a three-dimensional (3D) hydrocarbon spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of changing meteorological and oceanographic forces.

A stochastic modelling scheme was followed in this study, whereby SIMAP was applied to repeatedly simulate the defined credible spill scenarios using different samples of current and wind data. These data samples were selected randomly from an historic time-series of wind and current data representative of the study area. Results of the replicate simulations were then statistically analysed and mapped to define contours of percentage probability of contact at identified thresholds around the hydrocarbon release point.

The model simulates surface releases and uses the unique physical and chemical properties of a hydrocarbon type to calculate rates of evaporation and viscosity change, including the tendency to form oil in water emulsions. Moreover, the unique transport and dispersion of surface slicks and in-water components (entrained and dissolved) are modelled separately. Thus, the model can be used to understand the wider potential consequences of a spill, including direct contact of hydrocarbons due to surface slicks (floating hydrocarbon) and exposure of organisms to entrained and dissolved aromatic hydrocarbons in the water column.

During each simulation, the SIMAP model records the location (by latitude, longitude and depth) of each of the particles (representing a given mass of hydrocarbons) on or in the water column, at regular time steps. For any particles that contact a shoreline, the model records the accumulation of hydrocarbon mass that arrives on each section of shoreline over time, less any mass that is lost to evaporation and/or subsequent removal by current and wind forces.

The collective records from all simulations are then analysed by dividing the study region into a 3D grid. For surface hydrocarbons (floating oil), the sum of the mass in all hydrocarbon particles located within a grid cell, divided by the area of the cell, provides hydrocarbon concentration estimates in that grid cell at each model output time interval. For entrained and dissolved aromatic hydrocarbon particles, concentrations are calculated at each time step by summing the mass of particles within a grid cell and dividing by the volume of the grid cell. The process is also subject to the application of spreading filters that represent the expected mass distribution of each distinct particle. The concentrations of hydrocarbons calculated for each grid cell, at each time step, are then analysed to determine whether concentration estimates exceed defined threshold concentrations.

All hydrocarbon spill modelling assessments undertaken by RPS 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.

6.8.1.1 Hydrocarbon Characteristics

As part of the risk identification process, Woodside identified the range of credible hydrocarbon spill scenarios that may occur during the Petroleum Activities Program. These scenarios are considered in the risk assessments of MEEs (Sections 6.8.3 to 6.8.10) and unplanned hydrocarbon discharges are presented in Section 6.7.1. A summary of the characteristics of the hydrocarbons used as the basis for the modelling studies (including definition of contact thresholds) used to inform the assessment of MEEs is provided in Table 6-16.

Table 6-17: Characteristics of the hydrocarbon type used for modelling and ecotoxicological studies

Hydrocarbon Type	Density (g/cm^3 at 15 °C)	Viscosity (cP at 20 °C)	Component	Volatile	Semi-volatile	Low volatility	Residual	Aromatics
			Boiling point (BP)	*<180 °C*	*180 – 265 °C*	*265 – 380 °C*	*>380 °C*	*Of whole oil <380 °C*
			Carbon chain	*C4 to C10*	*C11 to C15*	*C16 to C20*	*>C20*	*C6+ (Benzene ring)*
Cossack light crude	0.7875	1.4	% total	52.2	20.5	12.0	15.3	14.5
			% aromatics	3.7	1.3	9.5	-	-
Diesel	0.829	4.0	-	6	34.6	54.4	5	-

Cossack Light Crude

Cossack light crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures it will remain in a liquid state over the annual temperature range observed on the NWS.

The mixture is composed of hydrocarbons that have a wide range of BPs and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP <180 °C), a further 20.5% should evaporate within the first 24 hours (BP >180 °C to <265 °C), and a further 12.0% should evaporate over several days (BP 265 °C to < 380 °C).

Selective evaporation of the lower BP components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. Although removing volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers.

The whole oil has low asphaltene content (<0.05%), indicating a low propensity to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute ~14.5% by mass of the whole oil, with a moderate proportion (7.4%) in the C4–C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolving a proportion of them into the water.

In terms of weathering, modelling indicates that a moderate proportion of Cossack light crude will tend to persist on the sea surface (15% after 7 days) during calm wind conditions, with negligible levels of entrainment (<0.5%) and around 75% of the spilled volume is expected to evaporate within the first 24 hours (Figure 6-4). For variable strength winds, modelling indicates that a higher percentage of Cossack light crude is likely to entrain and dissolve in the water column. Approximately 24 hours after the spill, ~24% of the oil mass is forecast to have entrained and a further 66% is forecast to have evaporated, leaving only a small percentage (~0.5%) of the oil floating on the sea surface (Figure 6-5).

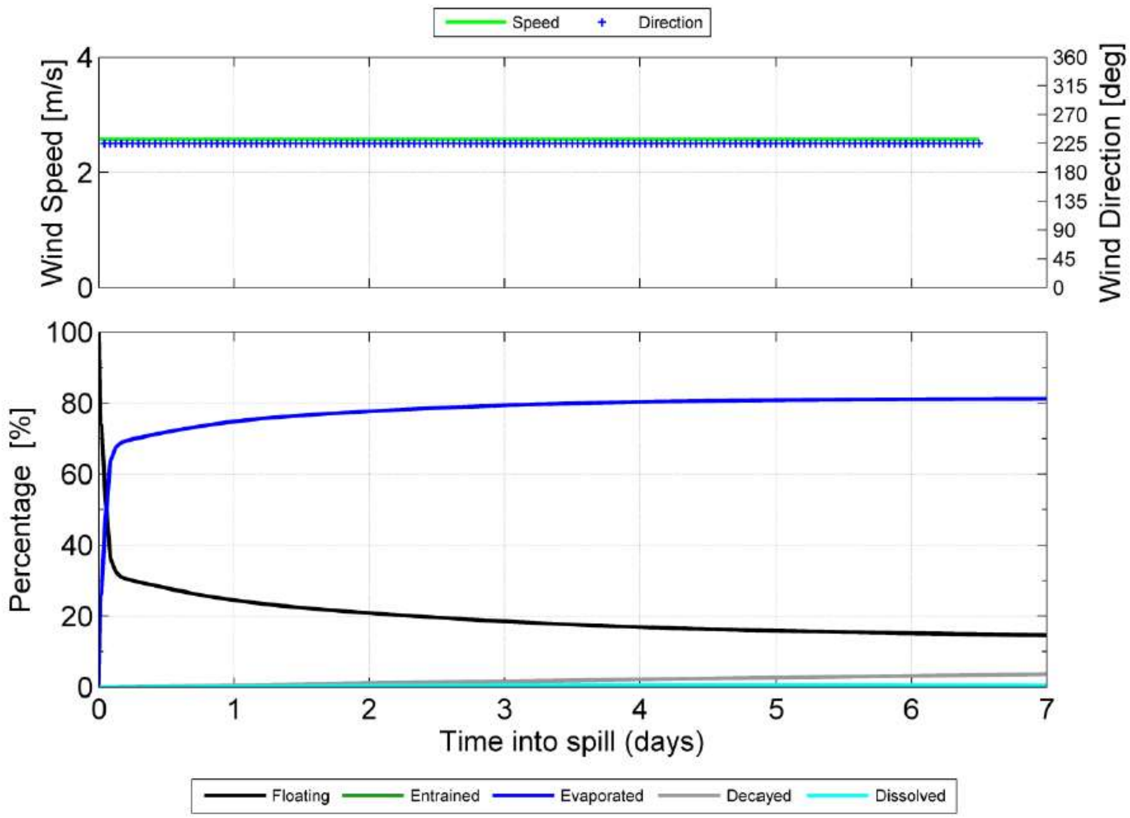

Figure 6-4: Proportional mass balance plot representing the weathering of Cossack light crude spilled onto the water surface as a one-off release (50 m³ over 1 hour) and subject to a constant 5 knots (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature

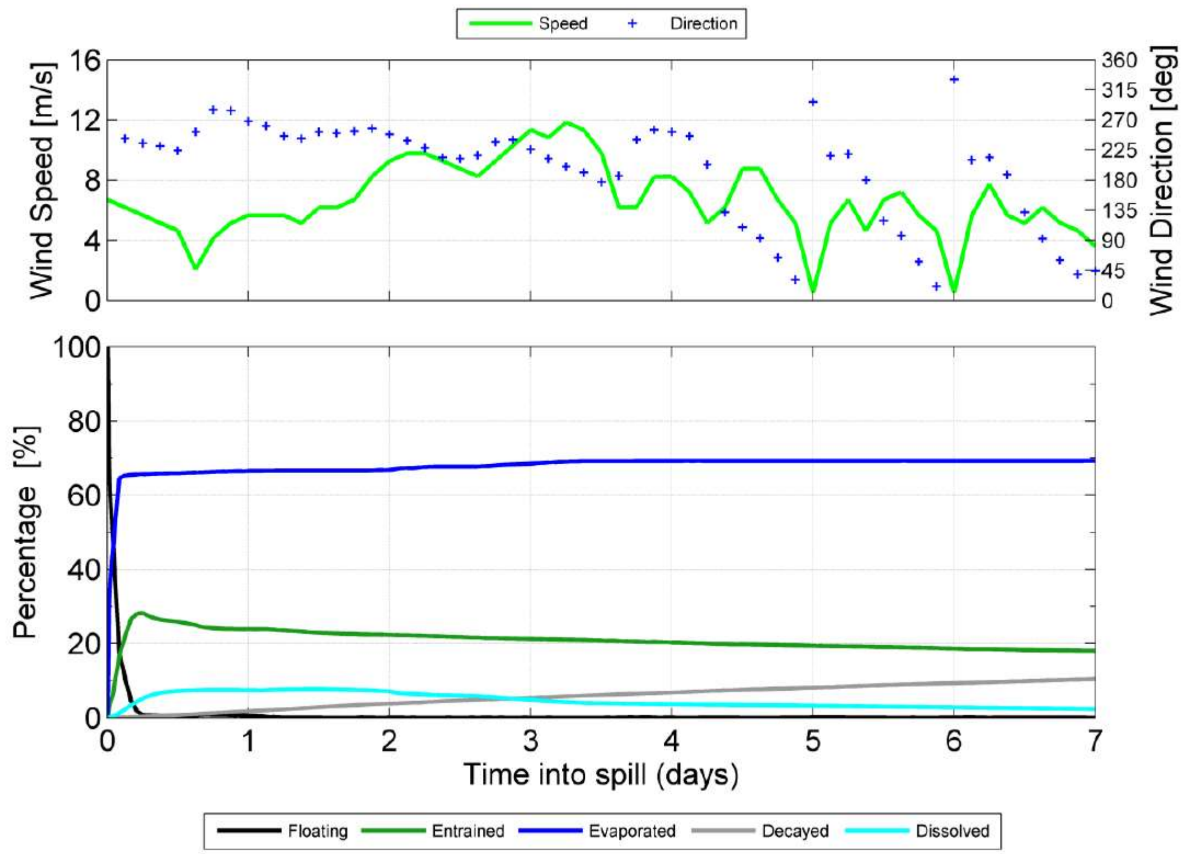

Figure 6-5: Proportional mass balance plot representing the weathering of Cossack light crude spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature

Diesel

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 (BP 180 °C to <265 °C); and a further 54% should evaporate over several days (BP 265 °C to <380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is ~3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), ~41% by mass of this oil is predicted to evaporate over the first few days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil tend to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-generated 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 dissolving the soluble aromatic fraction.

The mass balance forecast for the constant-wind case for diesel shows that ~40% of the oil is predicted to evaporate within 36 hours. Under these calm conditions most of the remaining oil on the water surface would weather at a slower rate due to being comprised of the longer-chain compounds with higher BPs. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 6-5), where the winds are of greater strength, entrainment of diesel into the water column is indicated to be significant. Approximately two days after the spill, around 50% 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 (<2%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves (approximately >6 m/s).

Biological and photochemical degradation is predicted to contribute to the decay of the floating slicks and oil droplets in the water column at an approximate rate of around 0.5% per day, for an accumulated total of about 3–4% after seven days in each wind case. However, given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay and/or evaporate over time scales of several weeks to a few months. This long weathering duration will extend the area of potential effect, requiring the break-up and dispersion of the slicks and droplets to reduce concentrations below the thresholds considered in this study.

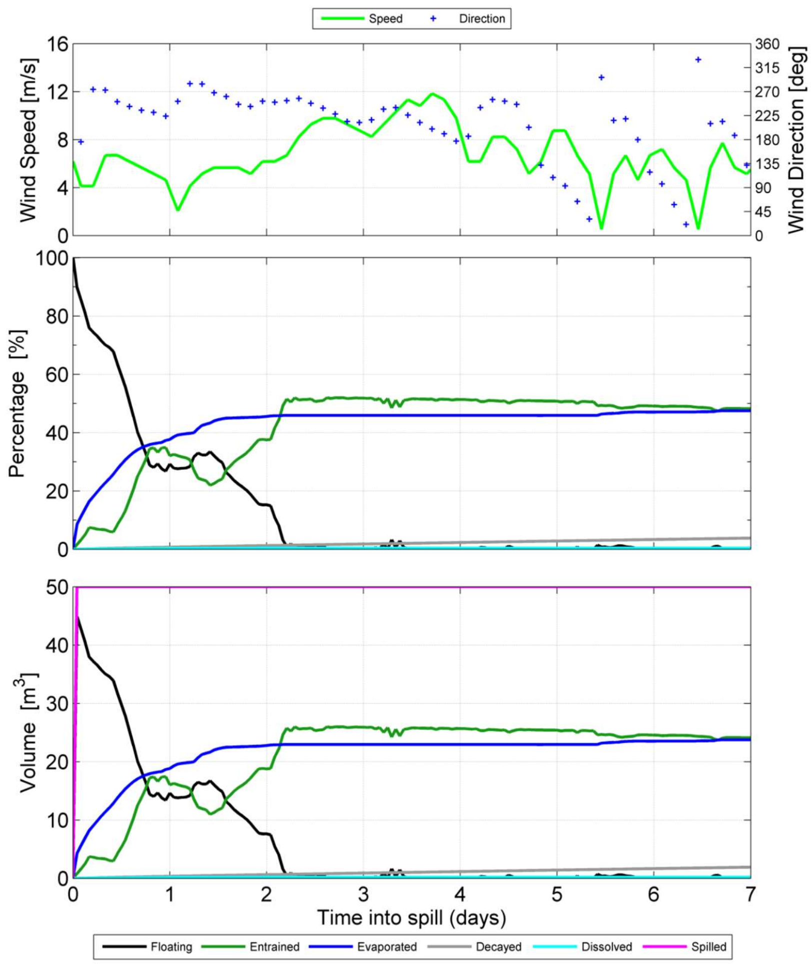

Figure 6-6: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of diesel spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable winds (top panel) at 27 °C water temperature

6.8.1.2 Environment that May Be Affected and Hydrocarbon Contact Thresholds

The outputs of the quantitative hydrocarbon spill modelling are used to assess the environmental consequence, 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.

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 mechanism of transportation, a different EMBA is presented for each fate. These EMBA together have defined 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 in Table 6-17 and described in the following subsections.

Table 6-18: Summary of thresholds applied to the quantitative hydrocarbon spill risk modelling results

Hydrocarbon Type	EMBA				Socio-cultural EMBA
	Surface hydrocarbon (g/m^2)	Dissolved hydrocarbon (ppb)	Entrained hydrocarbon (ppb)	Accumulated hydrocarbon (g/m^2)	Surface Hydrocarbon (g/m^2)
Cossack light crude	10	400	400	100	1
Diesel	10	500	500	10	-

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 (dull metallic colours) based on the relationship between film thickness and appearance (Bonn Agreement 2015) (Table 6-18). 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 ~10–25 g/m^2 (French et al. 1999, Koops et al. 2004, National Oceanic and Atmospheric Administration [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, though 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 will 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 contact.

Woodside recognises that hydrocarbons may be visible at low concentrations of approximately 1 g/m^2. The threshold for visible surface oil (1 g/m^2) has therefore been 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 6-17, 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 6-19: The Bonn Agreement oil appearance code

Appearance (following Bonn visibility descriptions)	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 Hydrocarbon Threshold Concentration

Cossack light crude

The threshold concentration value for dissolved hydrocarbons has been established based on results from ecotoxicity tests for Cossack Light Crude and is specific to the crude oil that is produced at the Okha FPSO (Ecotox Services Australia [ESA] 2012).

The ecotoxicity tests used a range of Water Accommodated Fractions (WAF) to expose the different test organisms. For each ecotoxicity test, samples of the WAF were analysed to determine the total aromatics (C6-C28) present. Gas chromatography for aliphatic/aromatic speciation and total petroleum hydrocarbon analysis was used for semi volatile fractions (C10-C14, C15-C28, C29-C36) and volatile fractions (C6-C9). The purpose of the threshold is to inform the assessment of the potential for toxicity impacts to sensitive marine biota.

The toxic effects of dissolved hydrocarbons is relatively well understood, and are generally considered to represent the bioavailable form of oil that dictates toxicity rather than total concentrations (Redman and Parkerton 2015). The ecotoxicity tests were undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well established. These ecotoxicity tests focus on the early life stages of test organisms, when organisms are typically at their most sensitive. The ecotoxicity tests were conducted on seven mainly tropical–subtropical species representative from six major taxonomic groups (Table 6-19).

Table 6-19 presents the results of ‘no observed effect concentrations’ (NOECs) for Cossack light crude. The NOECs for the organisms tested ranged from 407 ppb to 6895 ppb. Based on these ecotoxicity tests, a conservative threshold of 400 ppb has been adopted. The oil spill modelling is based on the dissolved aromatic hydrocarbon content of Cossask crude, providing a more accurate and conservative approach specifically aligned with the fields associated with the Okha facility. Similarly, thresholds for instantaneous contact with aromatic hydrocarbons are based on the toxicity calculated specifically for the aromatic hydrocarbon for Cossask crude. These thresholds are calculated based on exposure of organisms to dissolved aromatic hydrocarbons over periods of 1 to 96 hours and are, therefore, highly conservative when applied in an instantaneous contact setting as opposed to a cumulative, time driven period.

Marine diesel

The dissolved aromatic threshold of 500 ppb for diesel has been selected as a conservative threshold to be consistent with the National Energy Resources Australia (NERA) Environment Plan Reference Case: Consequence analysis of an accidental release of diesel (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).

Entrained Hydrocarbon Threshold Concentration

Cossack light crude

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 harmful 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 (e.g. physical coating of gills and body surfaces, and accidental ingestion) (National Research Council 2005).

The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for the WAF of oil hydrocarbons. However, it is likely this data specific to dissolved oil hydrocarbon represents a worst-case scenario owing to the fact that entrained oil hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved oil hydrocarbons. The thresholds for instantaneous contact with aromatic hydrocarbons are based on the toxicity calculated from the specific aromatic hydrocarbon characteristics for Cossask crude of 400 ppb (Table 6-19) (Jacobs 2019b), and therefore will represent a potential impact substantially lower than the NOEC. The entrained oil droplets may contain soluble compounds and hence have the potential to generate elevated concentrations similar to that of dissolved hydrocarbons. Dissolved hydrocarbons rather than total concentrations are generally considered to represent the bioavailable form of oil that dictates toxicity; therefore, this approach is considered conservative and precautionary.

The modelling of entrained hydrocarbons specifically represents the total volume of Cossask crude predicted to be entrained under metocean conditions. As discussed above, the total aromatic threshold is conservative and is based on the exposure of organisms for periods of 1 to 96 hours and therefore is highly conservative when used for instantaneous contact as opposed to a cumulative, time driven period.

Table 6-20: Summary of total aromatic NOECs for key life-histories of different biota based on toxicity tests for WAF of fresh Cossack (Okha) crude oil

Biota and Life Stage	Exposure duration (hrs)	NOEC – WAF concentration of unweathered crude oil showing no direct biological effect (ppb)
Sea urchin fertilisation	1	407
Sea urchin larval development	72	2496
Milky oyster larval development	48	1197
Micro-algal growth test	72	1554
Amphipod acute toxicity test	96	413
Copepod acute toxicity test	48	860
Larval fish imbalance test	96	6895
Kelp gemination test	72	682

Source: Ecotox Services Australia (2013)

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. Therefore, an entrained threshold of 500 ppb, consistent with the threshold for toxicity from dissolved components, is considered to be conservative.

Accumulated Hydrocarbons Threshold Concentration

French-McCay (2009, 2016, 2018) 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; therefore, ≥100 g/m^2 has been adopted as the threshold for shoreline accumulation.

6.8.2 MEEs Overview

Section 2.7 outlines the process for additional analysis and evaluation of MEEs. Sections 6.8.3 to 6.8.10 present the bowtie output for each MEE identified (Table 6-20).

Table 6-21: MEE events for the Okha facility

No.	Hazard	Top Event
MEE-01	Liquid hydrocarbons in reservoirs, wells, wellheads and Xmas trees	Loss of well containment
MEE-02	Liquid hydrocarbons in subsea equipment (flowlines, manifolds, risers and associated equipment)	Subsea equipment loss of containment
MEE-03	Liquid hydrocarbons in topsides equipment	Topsides loss of containment
MEE-04	Liquid hydrocarbons in the Okha offtake system	Loss of containment during offtake
MEE-05	Hydrocarbons in Okha FPSO cargo tanks	Cargo tank loss of containment
MEE-06	Liquid hydrocarbons in the Okha FPSO and associated infrastructure	Loss of structural integrity
MEE-07	Liquid hydrocarbons in subsea equipment and Okha FPSO (topsides equipment, offtake system, cargo tanks)	Loss of marine vessel separation
MEE-08	Lifting activities associated with Okha FPSO operations	Loss of control of suspended load

Each section includes a summary of the hazard description, hazard management, emergency response, ALARP summary and a list of SCE barriers identified on the bowties. Each group of SCEs is listed under Technical Performance Standards, with consistent naming conventions used across Woodside's process safety management processes (e.g. pipeline integrity SCEs are captured as P09 – Pipeline Systems).

Section 6.8.11 presents the generic SCE Failure and generic Human Error bowties that illustrate the causes, outcomes and controls/barriers in place to manage potential common cause event (CCE) failure mechanisms for MEE controls associated with generic SCE equipment failure (CCE-01), and also human error (CCE-02). Controls and specific measures are listed for both bowties. Human Error is managed via the WMS and the Generic Human Error bowtie is included in the MEE section for completeness.

ALARP is demonstrated through controls and barriers being analysed for selection based on their independence, prioritised in accordance with the Hierarchy of Controls where controls further up the hierarchy take precedence over controls further down, and further analysed to consider the type of effect the control provides. ALARP controls presented for MEE bowties are labelled in accordance with Type of Effect classifications presented in Table 6-21.

Woodside has developed a tailored ALARP position for hydrocarbon spill response, including EPOs, EPSs and MC for preparedness and response. The response arrangements are a mitigative control that applies to all MEEs where a hydrocarbon release may credibly occur. The hydrocarbon spill response arrangements are described in Appendix D.

Table 6-22: Barrier hierarchy and type of effect

Type of Effect	Legend	Description
Elimination (Technical)		Elimination controls form the 'first line of defence'. They eliminate the underlying hazard and therefore are the most effective category of control measure. If practicable, they should be selected in preference to any other type, as their existence removes the need for any other controls (e.g. a corrosion-resistant metal could replace the original material of construction).
Elimination (Administration)		
Prevention (Technical)		Prevention controls are intended to remove certain causes of incidents or reduce their likelihood. The corresponding hazard remains, but the frequency of incidents involving the hazard is lowered (e.g. introduction of regular maintenance programs can prevent the development of events involving the hazard). Where hazards and causes could not be 'eliminated', controls are required to prevent them from leading to unwanted events and consequences.
Prevention (Administration)		
Detection (Technical)		Detection controls are those that identify a potentially hazardous scenario (e.g. a change in operating parameters), allowing initiation of procedures or systems to prevent the cause occurring. Controls that detect the occurrence of events are often critical to being able to respond with other control measures that reduce the propagation of the events. Detection controls themselves often provide no actual control other than the awareness of the need to respond.
Detection Administration)		
Reduction/Control (Technical)		Reduction controls are intended to limit the scale and consequence of incidents. They include systems that detect incidents and take some action (e.g. to reduce the rate of leakage of a toxic gas) and also aspects such as inter-unit separation that prevent escalation of fire and explosion incidents. As there is always potential for controls to fail, additional measures are required to limit the scale and severity of any unwanted event or outcome that may arise, by providing the ability to intervene and limit the propagation of the events.
Reduction/Control (Administration)		

Type of Effect	Legend	Description
Mitigation (Technical)		Mitigation controls take effect in response to an incident. They include controls that lessen the significance or damage caused by an unwanted event. Such controls only take effect after the hazardous event and outcomes occur. Mitigation controls are generally those designed to protect personnel against the consequences of a hazard or to aid in recovering from the effects of the hazard.
Mitigation (Administration)		

6.8.3 Unplanned Hydrocarbon Release: Loss of Well Containment (MEE-01)

Context		
Well and Reservoirs– Section 3.5.2	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Release of hydrocarbons resulting from loss of subsea well containment.	-	X	X	X	X	X	X	B	A	0	M	LCS GP PJ RBA CV SV	Acceptable if ALARP	EPO 12

Description of Source of Risk

Background

A loss of well containment can lead to an uncontrolled release of reservoir hydrocarbons or other well fluids to the environment resulting in a well blowout. Woodside has identified a well blowout as the scenario with the worst-case credible environmental outcome as a result of this event. Due to the potential consequences, a loss of well containment is considered to be a MEE (MEE-01). A loss of well containment could occur because of:

- internal corrosion
- external corrosion
- erosion
- overpressure of the annuli
- fatigue
- loss of control of suspended load from vessel (operating near subsea wells).

A number of common failure causes due to human error and SCE Failures are presented in the generic Human Error and SCE failure bowties in Section 6.8.11.

Loss of Well Containment – Credible Scenarios

The Petroleum Activities Program includes production from a series of subsea wells (Section 3.5.2). A loss of well containment is not considered credible for the four temporary abandoned exploration wells (Lambert 5ST1, Cossack-1, Goodwyn-6 and Angel-1). One credible worst-case loss of well containment scenario was identified for the Petroleum Activities Program:

- Well blowout at seabed – highest flow rate subsea well (LH3).

The credible worst-case subsea release was based on the maximum credible release volume from the highest flow rate subsea well (LH3). The loss of well containment scenario was modelled to a duration of 77 days. The estimated time required to successfully drill a relief well was 58 to 77 days. This takes into account time to prepare, mobilise and set up a drilling rig and also intersect and kill the well. Refer to Table 6-22 for additional discussion of relief well timing. The characteristics of Cossack (Okha) light crude was used as the basis in the modelling (refer to Section 6.8.1 for additional information on modelling methods and environmental impact, thresholds and hydrocarbon characteristics justifications).

Table 6-23: Summary of worst-case loss of well containment hydrocarbon release scenario

Scenario	Hydrocarbon	Average Rate (m^3/day	Duration (days)	Depth (m)	Latitude (WGS84)	Longitude (WGS84)	Total Crude Release Volume (m^3)
Well blowout at seabed – subsea well with highest flow rate (LH3)	Cossack (Okha) light crude	2,414	77	80	19° 26' 58.47" S	116° 29' 16.23" E	185,915

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in well design and construction. In the company's recent history, it has not experienced any well integrity events that have resulted in significant releases or significant environmental impacts. The Okha facility has never experienced a worst-case loss of well containment in its operational history.

<u>Decision Type</u>

Decision Type B was applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications if the event is realised. To align with this decision type, a further level of analysis was applied using risk-based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling. CVs and SVs were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation.

The release of hydrocarbons as a result of well loss of containment is considered a MEE (MEE-01). The hazard associated with this MEE is hydrocarbons in subsea wells tied-back to the Okha facility.

<u>Quantitative Spill Risk Assessment</u>

Spill modelling of the worst-case credible loss of well containment spill scenario was undertaken by RPS APASA, on behalf of Woodside, over a 77-day simulation length to determine the fate of hydrocarbons released based on the assumptions in Section 6.8.1. Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volumes for all loss of well containment scenarios.

<u>Consequence</u>

The spatial extent and fate (including Weathering) of potential spilled hydrocarbon were considered during the impact assessment for a worst-case loss of well containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 4) and relevant literature and studies considering the effects of hydrocarbon exposure.

<u>Likelihood</u>

In accordance with the Woodside Risk Matrix, a worst-case loss of well containment has been defined as 0 (Remote). Information to support this likelihood determination is outlined below.

Review of industry statistics indicates that the probability of a loss of well containment for production wells is low (10.6% of blowouts) relative to other activities in other hydrocarbon provinces (Gulf of Mexico and the North Sea), such as exploration drilling (31.5% of blowouts), development drilling (23.6% of blowouts) and well workovers (20.5% of blowouts) (SINTEF 2017).

Separate analysis of blowout data collected between 1991 and 2010 in the North Sea and the Gulf of Mexico shows that only ten blowouts occurred during the production phase at a frequency of 1.36×10^{-5} blowouts per well year, with all these events occurring in the Gulf of Mexico and none in the North Sea (Scandpower 2013). North Sea standards of well design and operation are considered to be aligned with those applied by Woodside, as outlined in the Okha Well Operations Management Plan (WOMP). This data quantitatively supports the likelihood ranking as described above.

When considering likelihood from an 'experience' perspective, and considering likelihood of the environmental consequence of the blowout event, historic blowouts from production wells that have had a catastrophic impact to the environment ('A' consequence rating) have not occurred in the industry. This also further supports the likelihood ranking of 'Remote' for subsea wells.

Consequence Assessment

Environment that May be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling, which compiles data from multiple hypothetical worst-case spill simulations under a variety of weather and metocean conditions (as described in

Consequence Assessment
Section 6.8.1.2). The EMBA covers a larger area than the area that would be affected during any single spill event, and therefore represents the total extent of all locations where hydrocarbon thresholds could be exceeded from all modelling runs. The trajectory of a single spill would have a considerably smaller footprint. As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is discussed for each fate. <u>Surface Hydrocarbons</u> Quantitative hydrocarbon spill modelling results for surface hydrocarbons are shown in Table 6-23. The modelled surface hydrocarbons are forecast to drift in all directions, reflecting the competing influence of both surface currents and winds across the wide area, and may extend up to 57 km from the release site at concentrations above the EMBA impact threshold (10 g/m²). Modelling results indicate no contact with sensitive receptors by surface (floating) hydrocarbons above the impact threshold at probabilities of 1% or greater due to the rapid weathering (evaporation/entrainment) of the hydrocarbon, as shown in Table 6-23. At the 1 g/m² socio-cultural threshold a number of receptors are contacted with the highest probability found at Glomar Shoal (24%). <u>Entrained Hydrocarbons</u> Quantitative hydrocarbon spill modelling results for entrained hydrocarbons are shown in Table 6-23. The modelled entrained hydrocarbons are forecast to potentially drift in all directions, with the most likely directions of travel being to the north-east and south-west of the release site. Contact by entrained oil at concentrations equal to or greater than 400 ppb is predicted at the Montebello AMP (31% probability), Montebello State Marine Park (18% probability), Barrow Island (12% probability), Pilbara Islands – Southern Island Group (19% probability) and Muiron Islands State Marine Park (17% probability), as well as several other receptors with probabilities lower than 10% (Table 6-23). The maximum entrained oil concentration forecast for any receptor is predicted at 1.8 ppm at the Montebello AMP. Table 6-23 indicates entrained threshold concentration contact locations for receptors as identified by the modelling. <u>Dissolved Hydrocarbons</u> Quantitative hydrocarbon spill modelling results for dissolved hydrocarbons are shown in Table 6-23. The modelled dissolved hydrocarbons are forecast to potentially drift in all directions, with the most likely directions of travel being to the north-east and south-west of the release site, extending up to 565 km from the release site. Contact by dissolved aromatic hydrocarbons at concentrations equal to or greater than 400 ppb is predicted to be greatest at Montebello Marine Park (23% probability), Glomar Shoal (17% probability), and Rankin Bank (16% probability), with possible contact at several other receptors at probabilities lower than 10% (Table 6-23). The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 3.6 ppm at the Montebello Marine Park. <u>Accumulated Hydrocarbons</u> Quantitative hydrocarbon spill modelling results for accumulated hydrocarbons are shown in Table 6-23. The Pilbara Islands – Southern Island Group (31% probability), the Montebello Islands (22% probability), Barrow Island (13% probability), and Muiron Islands (15% probability), as well as several other receptors with probabilities lower than 10% (Table 6-23), are predicted to experience shoreline accumulation in excess of the 100 g/m^2 threshold. Potential for accumulation of oil on shorelines is predicted to be greatest at the Pilbara Islands – Southern Island Group. ***Consequence Assessment Summary*** Table 6-23 presents the full extent of the EMBA; i.e. the sensitive receptors and their locations that may be exposed to hydrocarbons (surface, entrained, dissolved and accumulated) at or above the set threshold concentrations in the Remote likelihood of a major hydrocarbon release from a loss of well integrity occurring 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 integrity during the Petroleum Activities Program are presented in the following sections.

Table 6-24: Key receptor locations and sensitivities potentially contacted above impact thresholds by the loss of well containment scenario with summary hydrocarbon spill contact (table cell values correspond to probability of contact [%])

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 and fate (%) (Cossack [Okha] light crude)				
		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 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 (foraging and internesting areas and significant nesting beaches)	Sea snakes	Whale sharks	Sharks and rays	Seabirds and/or migratory shorebirds	Pelagic fish populations	Resident /Demersal Fish	Fisheries – commercial	Fisheries – traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≤10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥400 ppb)	Dissolved aromatic hydrocarbon (≥400 ppb)	Accumulated hydrocarbons (>100 g/m²)
Offshore[24]	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		16	-	31	23	N/A
	Ningaloo AMP	✓	✓					✓		✓					✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓		-	-	1	1	N/A
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	3	-	4	2	N/A
	Argo-Rowley Terrace AMP	✓	✓					✓							✓	✓			✓			✓	✓	✓		✓			✓		7	-	1	1	N/A
Submerged Shoals and Banks	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			10	-	-	16	N/A
	Glomar Shoal	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			24	-	-	17	N/A
	Rowley Shoals – Clerke Reef state MP	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			-	-	-	-	2
	Rowley Shoals – Imperieuse Reef State MP	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			-	-	-	-	8
Islands	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		12	-	18	8	22
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓		✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	3	-	12	2	13
	Lowendal Islands (including State Nature Reserve)	✓	✓	✓	✓		✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	-	-	-	-	13
	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		13	-	19	4	31
	Pilbara Islands – Middle Island Group	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	-	-	4

[24] Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent.

Environmental setting	Location / name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure [WM0000PG10055394])																											Probability of hydrocarbon contact and fate (%) (Cossack [Okha] light crude)				
		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 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 (foraging and internesting areas and significant nesting beaches)	Sea snakes	Whale sharks	Sharks and rays	Seabirds and/or migratory shorebirds	Pelagic fish populations	Resident /Demersal Fish	Fisheries – commercial	Fisheries – traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≤10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥400 ppb)	Dissolved aromatic hydrocarbon (≥400 ppb)	Accumulated hydrocarbons (>100 g/m²)
	Pilbara Islands – Northern Island Group (Sandy Island Passage Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	-	-	7
	Muiron Islands (WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		8	-	17	10	15
	Dampier Archipelago	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		1	-	-	-	9
Mainland (nearshore waters)	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		2	-	1	1	8
	Exmouth Gulf	✓	✓		✓	✓	✓	✓				✓	✓		✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓			-	-	-	-	-
	Shark Bay WHA	✓	✓	✓	✓	✓	✓					✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		-	-	-	-	2
	Shark Bay – open Ocean Coast	✓	✓	✓	✓		✓	✓			✓	✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	-	-	2

Summary of Potential Impacts to Environmental Values(s)	
Summary of Potential Impacts to protected species	
Setting	***Receptor Group***
Offshore	***Cetaceans*** A range of cetaceans were identified as potentially occurring within the Operational Area and wider EMBA (Section 4.5.2.5). In the event of a loss of well containment, surface, entrained, and dissolved hydrocarbons exceeding environmental impact threshold concentrations may drift across habitat for cetacean species. Migratory routes and BIAs of cetaceans considered to be MNES may be affected, including humpback whales and pygmy blue whales (northbound and southbound migrations). Cetaceans that have direct physical contact with surface, entrained, or dissolved aromatic hydrocarbons may suffer surface fouling, ingestion of hydrocarbons (from prey, water and sediments), aspiration of oily water or droplets, and inhalation of toxic vapours (Deepwater Horizon Natural Resource Damage Assessment Trustees [DHNRDT] 2016). This may result in the irritation of sensitive membranes such as the eyes, mouth, digestive and respiratory tracts, and organs. Other potential impacts include impairment of the immune system, neurological damage (Helm et al. 2015), reproductive failure, other adverse health effects (e.g. lung disease, poor body condition), and mortality (DHNRDT 2016). Physical contact with hydrocarbons is likely to have biological consequences for these species. Given cetaceans maintain thick skin and blubber, external exposure to hydrocarbons may result in irritation to skin and eyes. Hydrocarbons may also be ingested, particularly by baleen whales (e.g. pygmy blue whales and humpback whales), which feed by filtering large volumes of water. Geraci (1988) has identified behavioural disturbance through avoidance of spilled hydrocarbons in several species of cetacean, suggesting that cetaceans have the ability to detect surface slicks. However, observations during spills have recorded larger whales (both mysticetes and odontocetes) and smaller delphinids travelling through and feeding in oil slicks. During the Deepwater Horizon spill, cetaceans were routinely seen swimming in surface slicks offshore and nearshore (Aichinger Dias et al. 2017). In a review of the impacts of large scale hydrocarbon spills on cetaceans, it was found that exposure to oil from the Deepwater Horizon resulted in increased mortality to cetaceans in the Gulf of Mexico (DHNRDT 2016), and long-term population level impacts to killer whales were linked to the Exxon Valdez tanker spill (Matkin et al. 2008). Cetacean populations that are resident within the EMBA may be susceptible to impacts from spilled hydrocarbons if they interact with an area affected by a spill. Such species are more likely to occupy coastal waters (refer to the Mainland and Islands section below for additional information). Suitable habitat for oceanic toothed whales (e.g. sperm whales) and dolphins is broadly distributed throughout the region and as such, impacts are unlikely to affect an entire population. Other species identified in Section 4.5.2.5 may also have possible transient interactions with the EMBA (refer to Table 6-23 for the list of receptor locations for cetaceans). Pygmy blue whales and humpback whales are known to migrate seasonally through the wider EMBA; however, the migration BIAs in the region for both species do not overlap the Operational Area. A major spill in May to November would coincide with humpback whale migration through the waters off the Pilbara, North West Cape and Shark Bay (Figure 4-9). A major spill in April–August or October–January would coincide with pygmy blue whale migration (Figure 4-8). Both pygmy blue and humpback whales are baleen whales, so are most likely to be significantly impacted by toxic effects when feeding. However, feeding during migrations is low level and opportunistic, with most feeding for both species occurring in the Southern Ocean. Fresh hydrocarbons (i.e. typically in the vicinity of the release location) may have a higher potential to cause toxic effects when ingested, while weathered hydrocarbons are considered to be less likely to result in toxic effects. As such, the risk of ingestion of hydrocarbons is low. Pygmy blue whale and humpback whale migrations are protracted through time and space (i.e. the whole population will not be within the EMBA), and as such, a spill from the loss of well integrity is unlikely to affect an entire population. The humpback whale calving BIA in Camden Sound is not predicted to be contacted by hydrocarbons above threshold concentrations. Entrained hydrocarbons above threshold levels are not predicted to extend into Exmouth Gulf, which is a resting BIA for humpback whales during their southern migration. However, they are predicted at low probabilities to travel along the outer edge of the Exmouth Gulf as they move around the North West Cape, resulting in a small section of the EMBA overlapping the outer boundary of the humpback whale resting BIA. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore cetacean species, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions. Potential impacts to inshore cetaceans and other marine mammals are discussed in the Mainland and Islands (nearshore) impacts discussion below.

Summary of Potential Impacts to Environmental Values(s)	
	Marine Turtles Adult sea turtles exhibit no avoidance behaviour when they encounter hydrocarbon spills (NOAA 2010). Therefore, contact with surface slicks or entrained hydrocarbon can result in hydrocarbons adhering to body surfaces (Gagnon and Rawson 2010) causing irritation of mucous membranes in the nose, throat and eyes, leading to inflammation and infection (NOAA 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 includes an increase in the production of white blood cells, and even a short exposure to hydrocarbons may affect the functioning of the salt gland (Lutcavage et al. 1995). Hydrocarbons in surface waters may also impact turtles when they surface to breathe as they may inhale toxic vapours. Their breathing pattern, involving large 'tidal' volumes and rapid inhalation before diving, results in direct exposure to petroleum vapours, which are the most toxic component of the hydrocarbon spill (Milton and Lutz 2003). This can lead to lung damage and congestion, interstitial emphysema, inhalant pneumonia, and neurological impairment (NOAA 2010). Contact with entrained hydrocarbons can result in hydrocarbons adhering to body surfaces, causing irritation of mucous membranes in the nose, throat and eyes and leading to inflammation and infection (Gagnon and Rawson 2010). An internesting BIA for flatback turtles overlaps the Goodwyn-6 suspended exploration well section of the Operational Area; however, the boundary of the BIA is 18 km from the Okha FPSO. Although this BIA overlaps the Operational Area, the Operational Area is unlikely to represent important habitat for marine turtles as there is an absence of potential nesting or foraging habitat for turtles (i.e. no emergent islands, reef habitat or shallow shoals) and the water is deep (~75 m to 130 m). However, it is acknowledged that there are significant nesting and foraging sites along the mainland coast and islands of the region, including Dampier Archipelago and the Montebello Island, and that a number of BIAs overlap the EMBA (Section 4.5.2.6 and Table 4-7). In particular the internesting BIAs and habitat critical to the survival of a species for loggerhead and hawksbill turtles extend for ~20 km from known nesting locations, and for ~60 km for flatback turtles. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore foraging marine turtles, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions. Potential impacts to nesting and internesting marine turtles are discussed in the Mainland and Islands (nearshore) impacts discussion below.
	Sea snakes Impacts to sea snakes from direct contact with hydrocarbons are likely to result in similar physical effects to those recorded for marine turtles. They may include potential damage to the dermis and irritation to mucus membranes of the eyes, nose and throat (International Tanker Owners Pollution Federation [ITOPF] 2011a). They may also be impacted when they return to the surface to breathe and inhale the toxic vapours associated with the hydrocarbons, resulting in damage to their respiratory system. In general, sea snakes frequent the waters of the continental shelf area around offshore islands and potentially submerged shoals (water depths <100 m; see Submerged Shoals below). It is acknowledged that sea snakes may be present in the Operational Area and are present in the wider EMBA. Their abundance is not expected to be high in the deepwater and offshore environment. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore sea snakes, with consequence severity dependent on the duration and extent of a spill in relation to the distribution of sea snakes. Potential impacts to inshore and offshore reef associated sea snakes are discussed in the Submerged Shoals and Banks and Mainland and Islands (nearshore) impacts discussion below.
	Sharks, Sawfish and Rays Hydrocarbon contact may affect whale sharks through ingestion of entrained or 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 (see Mainland and Islands (nearshore waters) below). Whale sharks may carry out opportunistic feeding in offshore waters and the Operational Area. The EMBA overlaps the whale shark foraging BIA identified in Section 4.5.2.7 and Figure 4-10, within which whale sharks are seasonally present between April and October. Impacts to sharks and rays may occur through direct contact with hydrocarbons, or through contamination of the tissues and internal organs, either through direct contact or through consumption of prey. As gill breathing

Summary of Potential Impacts to Environmental Values(s)	
	organisms, sharks and rays may be vulnerable to toxic effects of dissolved hydrocarbons entering the body via the gills, and entrained hydrocarbons via coating of the gills inhibiting gas exchange. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore shark, sawfish and ray species, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions. Potential impacts to inshore and offshore reef associated sharks, sawfish and rays are discussed in the Submerged Shoals and Banks and Mainland and Islands (nearshore) impacts discussion below.
	Seabirds and/or Migratory Shorebirds Offshore waters are potential foraging grounds for seabirds associated with the coastal roosting and nesting habitat (e.g. Ningaloo, Muiron Islands and the Barrow/Montebello/Lowendal Island Group). There are confirmed foraging grounds off Ningaloo and the Barrow/Montebello/Lowendal Island Group. Foraging and breeding BIAs for a number of seabirds and migratory shorebirds overlap with the EMBA (Section Table 6-23 and Table 4-5): • the wedge-tailed shearwater (peak use August–April) • the roseate tern • the lesser crested tern • the fairy tern • the little tern • the lesser frigatebird • white-tailed tropic bird • brown booby • little tern. Seabirds and migratory birds are particularly vulnerable to contact with floating hydrocarbons, which may mat feathers. This may lead to hypothermia from loss of insulation, and to ingestion of hydrocarbons when preening to remove hydrocarbons; both impacts may result in mortality (Hassan and Javed 2011). 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 (AMSA 2013, International Petroleum Industry Environmental Conservation Association [IPIECA] 2004): • plumage fouling and hypothermia (loss of thermoregulation) • decreased buoyancy and consequent increased potential to drown • inability to fly or feed • anaemia • pneumonia • and irritation of eyes, skin, nasal cavities and mouths. Longer-term exposures may potentially impact seabird populations through loss of reproductive success, malformation of eggs or chicks (AMSA 2013), or mortality of individuals from oiling of feathers or the ingestion of hydrocarbons. A hydrocarbon spill may result in surface slicks disrupting a significant portion of the foraging habitat for seabirds, including foraging BIAs, which are generally associated with breeding habitats. Seabird distributions are typically concentrated around islands, so hydrocarbons near nesting/roosting areas may result in increased numbers of seabirds being impacted, with many species of seabirds, such as the wedge-tailed shearwater and the various species of tern, foraging relatively close to breeding islands/colonies. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore seabirds and migratory shorebirds, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions. Potential impacts to coastal and offshore island associated birds are discussed in the Mainland and Islands (nearshore) impacts discussion below.

Summary of Potential Impacts to Environmental Values(s)	
Submerged Shoals and Banks	***Marine Turtles*** There is the potential for marine turtles to be present at submerged shoals such as Rankin Bank, Glomar Shoal and Rowley Shoals. These shoals and banks may, at times, be foraging habitat for marine turtles, given the coral and filter feeding biota associated with these areas. Satellite tracking of individual green turtles in the nearshore environment of the NWS did not indicate any overlap of the tracked post-nesting migratory routes and the Operational Area. However, it is acknowledged that individual marine turtles may be present at Glomar Shoal, Rankin Bank, Rowley Shoals and the surrounding areas. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to foraging marine turtles, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions. Potential impacts to nesting and internesting marine turtles are discussed in the Mainland and Islands (nearshore) impacts discussion below.
	Sea snakes There is the potential for sea snakes to be present at submerged shoals such as Glomar Shoal, Rankin Bank and Rowley Shoals. The potential impacts of exposure are as discussed previously in Offshore – Sea snakes. Sea snake species in Australia generally show strong habitat preferences (Heatwole and Cogger 1993); species that have preferred habitats associated with submerged shoals and oceanic atolls may be disproportionately affected by a hydrocarbon spill affecting such habitat. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore reef associated sea snakes, with consequence severity dependent on the duration and extent of a spill in relation to the distribution of sea snakes. Potential impacts to inshore sea snakes are discussed in the Mainland and Islands (nearshore) impacts discussion below.
	Sharks, Sawfish and Rays There is the potential for resident shark and ray populations to be impacted directly from hydrocarbon contact, or indirectly through contaminated prey or loss of habitat. Spill model results indicate Glomar Shoal and Rankin Bank are predicted to be contacted by dissolved hydrocarbons above threshold concentrations). Shark and ray species that have associations with submerged shoals and oceanic atolls may be more susceptible to a reduction in habitat quality resulting from a hydrocarbon spill. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to offshore reef associated shark, sawfish and ray species, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions. Potential impacts to inshore associated sharks, sawfish and rays are discussed in the Mainland and Islands (nearshore) impacts discussion below.
Mainland and Islands (Nearshore Waters)	***All Species*** The information provided on protected species in this section is in addition to that provided in the preceding Offshore and Oceanic Reefs and Submerged Banks and Shoals sections. Refer to these preceding sections for additional discussion of protected species.
	Cetaceans and Dugongs In addition to a number of whale species that may occur in nearshore waters (refer to Section 4.5.2.5) or the full list of EPBC listed cetacean species identified by the PMST with potential to occur within the EMBA), coastal populations of small cetaceans and dugongs are known to reside or frequent nearshore waters, including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/ Lowendal Islands Group, Pilbara Southern Island Group (see Table 6-23) which may be potentially impacted by entrained and dissolved hydrocarbons exceeding threshold concentrations in the event of a loss of well containment. The predicted EMBA extends past Exmouth Gulf towards Shark Bay. The Exmouth Gulf is a known humpback whale aggregation area on the annual southern migration (September to December); therefore, humpbacks moving into the Gulf may be exposed to hydrocarbons above thresholds levels. However, entrained and dissolved hydrocarbons concentrations above thresholds are not expected within Exmouth Gulf itself. No hydrocarbon contact at or above threshold concentrations is expected for Camden Sound, an important calving area for humpback whales. 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

Summary of Potential Impacts to Environmental Values(s)	
	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 worst-affected areas. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to inshore cetacean species and dugongs, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions.
	Marine Turtles Several marine turtle species use nearshore waters and shorelines for foraging and breeding (including internesting), with significant nesting beaches along the mainland coast and islands in potentially impacted locations such as the Dampier Archipelago, Montebello/Barrow/Lowendal Islands Group, Pilbara Islands (Northern, Middle, and Southern Island Groups), and Ningaloo Reef. There are distinct breeding seasons, as detailed in Section 4.5.1.3. The nearshore waters of these turtle habitat areas may be exposed to surface, entrained or dissolved hydrocarbons exceeding threshold concentrations, and accumulated hydrocarbons above threshold concentrations. A number of BIAs have been identified for marine turtles, including nesting, internesting and foraging areas. A hydrocarbon spill above impact thresholds in these areas may result in impacts to biologically important behaviours. During the breeding season, turtle aggregations near nesting beaches within the wider EMBA are most vulnerable due to greater turtle densities, and potential impacts may occur at the population level of some marine turtle species. The potential impacts of exposure are as discussed previously in Offshore – Marine Turtles. In the nearshore environment, turtles can ingest hydrocarbons when feeding (e.g. on oiled seagrass stands/macroalgae) or can be indirectly affected by loss of food source (e.g. seagrass due to dieback from hydrocarbon exposure) (Gagnon and Rawson 2010). In addition, hydrocarbon exposure can impact turtles during the breeding season at nesting beaches. Contact with gravid adult females or hatchlings may occur on nesting beaches (accumulated hydrocarbons) or in nearshore waters (entrained hydrocarbons) where hydrocarbons are predicted to make shoreline contact. Results from studies of nesting beaches subject to extensive oil pollution from the Deepwater Horizon spill indicated a significant reduction (~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. There was a significant increase in nesting density in the years immediately following the spill, with 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 ~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 reduced turtle numbers and nesting density; however, it would not be expected to result in elimination of a population. 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. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to nesting marine turtles, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' mating and nesting seasons and overall distributions.
	Sea snakes Impacts to sea snakes for the mainland and island nearshore waters from direct contact with hydrocarbons may occur and may include potential damage to the dermis and irritation to mucous membranes of the eyes, nose and throat (ITOPF 2011a).

Summary of Potential Impacts to Environmental Values(s)	
	Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to sea snakes, with consequence severity dependent on the duration and extent of a spill in relation to the distribution of sea snakes.
	Sharks, Sawfish and Rays Whale sharks and manta rays are known to frequent the Ningaloo Reef system and the Muiron Islands (forming feeding aggregations in late summer/autumn). Whale sharks and manta rays generally transit along the nearshore coastline and are vulnerable to surface, entrained and dissolved aromatic hydrocarbon spill impacts, with both taxa having similar modes of feeding. Whale sharks are versatile feeders, filtering large amounts of water over their gills, catching planktonic and nektonic organisms (Jarman and Wilson 2004). Whale sharks at Ningaloo Reef have been observed using two different feeding strategies, including passive subsurface ram-feeding and active surface feeding (Taylor 2007). Passive feeding involves 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). Individuals that are present in worst-affected spill areas would have the potential to ingest toxic amounts of entrained or dissolved aromatic hydrocarbons into their body. Large amounts of ingested hydrocarbons may affect endocrine and immune systems in the longer term. The presence of hydrocarbons may displace whale sharks from the area where they normally feed and rest, and potentially disrupt migration and aggregations to these areas in subsequent seasons. Whale sharks may also be affected indirectly by surface, entrained or dissolved aromatic hydrocarbons through the contamination of their prey. The preferred food of whale sharks are fish eggs and phytoplankton, which are abundant in the coastal waters of Ningaloo Reef in late summer/autumn, driving the annual arrival and aggregation of whale sharks in this area. If the spill event occurred during the spawning season, this important food supply (in worst spill-affected areas of the reef) may be diminished or contaminated. The contamination of their food supply and the subsequent ingestion of this prey by the whale shark may also result in long-term impacts as a result of bioaccumulation. There is the potential for other resident shark and ray (e.g. sawfish species identified in Section 4.5.2.7) populations to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat. Table 6-23 indicates the receptor locations predicted to be impacted from entrained and/or dissolved aromatic hydrocarbons to the benthic communities of nearshore, subtidal communities, and it is considered that there is the potential for habitat loss to occur. Therefore, the consequences to resident shark and ray populations (if present) from loss of habitat, may result in a disruption to a significant portion of the population; however, it is not expected to impact the overall viability of the population. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to inshore associated shark, sawfish and ray species, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions.
	Seabirds and/or Migratory Shorebirds In the event of a major spill, there is the potential for seabirds, and resident, non-breeding overwintering shorebirds that use the nearshore waters for foraging and resting, to be exposed to entrained, dissolved, and accumulated hydrocarbons. This could result in lethal or sublethal effects. Although breeding oceanic seabird species can travel long distances to forage in offshore waters, most breeding seabirds tend to forage in waters near their breeding colony. This results in relatively higher seabird densities in these areas during the breeding season, making these areas particularly sensitive in the event of a spill. Pathways of biological exposure that can result in impact may occur through ingesting contaminated fish (nearshore waters) or invertebrates (intertidal foraging grounds such as beaches, mudflats and reefs). Ingestion can also lead to internal injury to sensitive membranes and organs (IPIECA 2004). Whether the toxicity of ingested hydrocarbons is lethal or sublethal 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. Important areas for foraging seabirds and migratory shorebirds are identified in Section 4.5.2.8. Refer to Table 6-24 for locations within the predicted extent of the EMBA that are identified as habitat for seabirds and migratory shorebirds. Suitable habitat for seabirds and shorebirds are broadly distributed along the mainland and nearshore island coasts within the EMBA. Important nesting and resting areas include:

Summary of Potential Impacts to Environmental Values(s)	
	• Muiron Islands • Ningaloo Coast • Montebello/Barrow/Lowendal Islands Group (including known nesting habitats on Boodie, Double and Middle Islands) • Pilbara Islands North, Middle, and South Island Group (refer to Section 4.5.2.3 for additional information, including BIAs within the wider EMBA). Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to inshore associated seabirds and migratory shorebirds, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements, breeding seasons and distributions.

Summary of potential impacts to other species	
Setting	***Receptor Group***
All Settings	***Pelagic Fish Populations*** Fish mortalities are rarely observed to occur as a result of hydrocarbon spills (ITOPF 2011b). This has generally been attributed to the possibility that pelagic fish are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Fish that have been exposed to dissolved aromatic hydrocarbons are capable of eliminating the toxicants once placed in clean water, so individuals exposed to a spill are likely to recover (King et al. 1996). Where fish mortalities have been recorded, the spills (resulting from the groundings of the tankers *Amoco Cadiz* in 1978 and the *Florida* in 1969) have occurred in sheltered bays. Laboratory studies have shown that adult fish are able to detect hydrocarbons in water at very low concentrations, and large numbers of dead fish have rarely been reported after hydrocarbon spills (Hjermann et al. 2007). This suggests that juvenile and adult fish are capable of avoiding water contaminated with high concentrations of hydrocarbons. However, sublethal impacts to adult and juvenile fish may be possible, given long-term exposure (days to weeks) to polycyclic aromatic hydrocarbon (PAH) concentrations (Hjermann et al. 2007), which are typically the most toxic components of hydrocarbons. Light molecular weight aromatic hydrocarbons (i.e. one- and two-ring molecules) are generally soluble in water, which increases bioavailability to gill-breathing organisms such as fish. The effects of exposure to oil on the metabolism of fish appears to vary according to the organs involved, exposure concentrations and route of exposure (waterborne or food intake). Oil reduces the aerobic capacity of fish exposed to aromatics in the water and, to a lesser extent, affects fish consuming contaminated food (Cohen et al. 2005). The liver, a major detoxification organ, appears to be the organ where anaerobic activity is most impacted, probably increasing anaerobic activity to help eliminate ingested oil from the fish (Cohen et al. 2005). Fish are perhaps most susceptible to the effects of spilled oil in their early life stages, particularly during egg and planktonic larval stages, which can become entrained in spilled oil. Contact with oil droplets can damage feeding and breathing apparatus of embryos and larvae (Fodrie and Heck 2011). The toxic hydrocarbons in water can result in genetic damage, physical deformities and altered developmental timing for larvae and eggs exposed to even low concentrations over prolonged timeframes (days to weeks) (Fodrie and Heck 2011). More subtle, chronic effects on the life history of fish as a result of exposure in early life stages to hydrocarbons include disruption to complex behaviours such as predator avoidance, reproductive and social behaviour (Hjermann et al. 2007). Prolonged exposure of eggs and larvae to weathered concentrations of hydrocarbons in water has also been shown to cause immunosuppression and allows expression of viral diseases (Hjermann et al. 2007). PAHs have also been linked to increased mortality and stunted growth rates of early life history (pre-settlement) of reef fishes, as well as behavioural impacts that may increase predation of post-settlement larvae (Johansen et al. 2017). However, the effect of a hydrocarbon spill on a population of fish in an area with fish larvae and/or eggs, and the extent to which any of the adverse impacts may occur, depends greatly on prevailing oceanographic and ecological conditions at the time of the spill and its contact with fish eggs or larvae. Demersal species are associated with the Ancient Coastline KEF, which overlaps the Operational Area. Additional KEFs that may host relatively diverse or abundant fish assemblages compared to relatively featureless continental shelf habitats occur within the wider EMBA: • Continental Slope Demersal Fish Communities KEF (68 km west), which has a highly diverse fish assemblage with a high degree of endemism (DoEE 2019)

Summary of potential impacts to other species	
	• Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF (260 km south-west), which has been shown to host demersal fish (BMT Oceanica 2016) • Glomar Shoal KEF (37 km east), which is important area for a number of commercial and recreational fish species such as rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Falkner et al. 2009) • Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals KEF (308 km north-east), which has high species richness, high biological productivity, and hosts aggregations of marine life (DoEE 2019) • Exmouth Plateau KEF (181 km west), which is an important area of biodiversity (DoEE 2019) • Commonwealth Waters adjacent to Ningaloo Reef KEF (204 km south-west), which has high biological productivity and hosts a yearly aggregation of whale sharks (DoEE 2019). Mortality and sublethal effects may impact populations located close to a well blowout and within the EMBA for entrained/dissolved aromatic hydrocarbons (≥400 ppb). 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. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to pelagic fish species, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions.

Summary of Potential Impacts to Marine Primary Producers	
Setting	***Receptor Group***
Submerged Shoals	The waters overlying the Rankin Bank and Glomar Shoal have the potential to be exposed to dissolved hydrocarbons above threshold concentrations (≥400 ppb). Potential biological impacts could include sublethal stress and, in some instances, total or partial mortality of sensitive benthic organisms such as corals and the early life stages of resident fish and invertebrate species. Other submerged shoals and banks within the wider EMBA (e.g. Rowley Shoals) are not predicted to be exposed to entrained or dissolved hydrocarbons above threshold concentrations, but may be exposed to accumulated shoreline hydrocarbons above impact thresholds (Table 6-23). Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to primary producer groups at Rankin Bank and Glomar Shoal, with lower consequence severity predicted for Rowley Shoals given its increased distance from the potential release location.
Mainland and Islands (nearshore waters)	***Coral Reef*** The quantitative spill risk assessment indicates there would be potential for coral reef habitat to be exposed to dissolved and entrained hydrocarbons at locations including the Montebello Islands, Barrow Island, Lowendal Islands, discrete locations within the Pilbara Islands Southern Island Group, Muiron Islands and low potential to contact the Ningaloo Coast (Table 6-23). The shallow coral habitats are most vulnerable to hydrocarbon coating by direct contact with surface slicks during periods when corals are exposed at spring low tides. Water-soluble hydrocarbon fractions associated with surface slicks are also known to cause high coral mortality via direct physical contact of hydrocarbon droplets to sensitive coral species, such as the branching coral species (Shigenaka 2001). While surface slicks are not expected to form in nearshore waters, accumulated hydrocarbons along the shoreline are predicted to occur, which could impact on intertidal coral habitats. The duration of surface slick contact with the reef flat may be reduced, as the slick will likely be lifted off the reef by the flooding tide; however, exposure will be prolonged where hydrocarbons adhere. There is significant potential for lethal impacts due to the physical hydrocarbon coating of sessile benthos, with likely significant mortality of corals (adults, juveniles and established recruits) at the small spill-affected areas. This particularly applies to branching corals, which are reported to be more sensitive than massive corals (Shigenaka 2001). Exposure to entrained hydrocarbons/dissolved aromatic hydrocarbons (≥400 ppb) has the potential to result in lethal or sublethal 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. 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. Sublethal effects to corals may include polyp retraction, changes in feeding, bleaching (loss of zooxanthellae), increased mucous production resulting in reduced growth rates, and impaired reproduction (Negri and Heyward 2000). This could result in impacts to the shallow water fringing coral communities/reefs of the offshore islands (e.g. Barrow/Montebello/Lowendal Islands, Pilbara Southern and Northern Island

Summary of Potential Impacts to Marine Primary Producers	
	Groups) and the mainland coast (e.g. Ningaloo Coast). With reference to Ningaloo Reef, wave-induced water circulation flushes the lagoon and may promote removal of entrained and dissolved hydrocarbons from this particular reef habitat. Under typical conditions, breaking waves on the reef crest induce a rise in water level in the lagoon, creating a pressure gradient that drives water in a strong outward flow through channels. These channels are across as much as 15% of the length of Ningaloo Reef (Taylor and Pearce 1999). If a spill occurs at the time of coral spawning at potentially affected coral locations, or in the general peak period of biological productivity, there is the potential for a significant reduction in successful fertilisation and coral larval survival, due to the sensitivity of coral early life stages to hydrocarbons (Negri and Heyward 2000). Such impacts are likely to result in the failure of recruitment and settlement of new population cohorts. In addition, some non-coral species may be affected via direct contact with entrained and dissolved aromatic hydrocarbons, resulting in sublethal impacts and in some cases mortality—particularly 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 depend 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 typically relies on coral larvae from neighbouring coral communities that have either not been affected or only partially impacted. For example, there is evidence that Ningaloo Reef corals and fish are partly self-seeding, with the supply of larvae from locations within Ningaloo Reef of critical importance to the healthy maintenance of the coral communities (Underwood 2009). Recovery at other coral reef areas may not be aided by a large supply of larvae from other reefs, with levels of recruits after a disturbance event only returning to previous levels after the numbers of reproductive corals had also recovered (Gilmour et al. 2013). Therefore, a worst-case hydrocarbon spill scenario has the potential to result in catastrophic long-term impacts to coral populations within the EMBA, with consequence severity predicted to be greatest at reefs closest to the potential release location (e.g. Montebello Islands).
	Seagrass Beds/Macroalgae and Mangroves Spill modelling has predicted that entrained, dissolved, and accumulated hydrocarbons above threshold concentrations have the potential to contact a number of discrete shoreline sensitive receptors, such as those supporting biologically diverse, shallow subtidal and intertidal communities. The variety of habitat and community types, from the upper subtidal to the intertidal zones support a high diversity of marine life and are used as important foraging and nursery grounds by a range of invertebrate and vertebrate species. Depending on the trajectory of the entrained/dissolved plume, macroalgal/seagrass communities including the Barrow/Montebello/Lowendal Islands, the Pilbara Islands (documented as low and patchy cover), and the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms), all have the potential to be exposed (see Table 6-23 for a full list of receptors within the EMBA). Seagrass in the subtidal and intertidal zones have different degrees of exposure to hydrocarbon spills. Subtidal seagrass is generally considered much less vulnerable to surface oil spills than intertidal seagrass, primarily because freshly spilled hydrocarbons, including crude oil, float under most circumstances. Dean et al. (1998) found that oil mainly affects flowering; therefore, species that are able to spread through apical meristem growth are not as affected (such as *Zostera*, *Halodule* and *Halophila* species). Seagrass in the intertidal zone is particularly vulnerable, as it may come into direct contact with surface hydrocarbons, as well as entrained components, which can smother and kill seagrasses if it coats their leaves and stems (Taylor and Rasheed 2011). This conclusion is supported by Howard et al. (1989) who noted that surface hydrocarbon spills that become stranded on the seagrass and smother it during the rise and fall of the tide can result in reduced growth rates, blackened leaves and mortality. Wilson and Ralph (2011) concluded that long-term impacts to seagrass are unlikely unless hydrocarbons are retained within the seagrass meadow for a sustained duration. 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 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.

Summary of Potential Impacts to Marine Primary Producers	
	Physical contact with entrained hydrocarbon droplets could cause sublethal stress, causing reduced growth rates and reduced tolerance to other stress factors (Zieman et al. 1984). Mangrove habitat and associated mudflats and salt marsh at Ningaloo Coast (small habitat areas), the Pilbara islands, and the Montebello Islands were identified within the EMBA (see Table 6-23 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 sublethal 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 (NOAA 2014). The hydrocarbons comprise a proportion of persistent residual fractions. Therefore, deposited hydrocarbons are likely to persist in the sediment, potentially causing chronic sublethal toxicity impacts beyond immediate physical and acute effects, which may delay recovery in an affected area. Recovery of mangroves from oil spills can take 20–30 years (NOAA 2014); therefore, recovery from any impacts would be long-term (>10 years). Entrained/dissolved hydrocarbon impacts may include sublethal 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 sublethal in-water toxic effects. This may result in mortality or impairment of growth, survival and reproduction. In addition, there is the potential for secondary impacts on shorebirds, fish, sea turtles, rays and crustaceans that use these intertidal habitat areas for breeding, feeding and nursery habitat purposes. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to seagrass beds, macroalgae communities and mangroves within the EMBA, with consequence severity predicted to be greatest at receptors closest to the potential release location (e.g. Montebello Islands).

Summary of Potential Impacts to Other Habitats and Communities	
Setting	***Receptor Group***
Offshore	***Benthic Fauna Communities*** In the event of a major release at the seabed, the stochastic spill model predicted hydrocarbons droplets would be entrained, rapidly transporting them to the sea surface. As a result, the low sensitivity benthic communities associated with the unconsolidated, soft sediment habitat and any epifauna (filter feeders) associated with the Canyons KEF and the Continental Slope Demersal Fish Communities KEF (Section 4.7.5) within the wider EMBA are not expected to have widespread exposure to released hydrocarbons. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to seabed and associated epifauna and infauna within the EMBA, with impacts predicted to be greatest for habitats closest to the potential release location.
	Open Water – Productivity/Upwelling Primary production by plankton (triggered by sporadic upwelling events in the offshore waters) is an important component of the primary marine food web. Planktonic communities are generally mixed, including phytoplankton (cyanobacteria and other microalgae), secondary consuming zooplankton (e.g. copepods), and the eggs and larvae of fish and 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 (ITOPF 2011a). Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to plankton populations within the EMBA, with impacts predicted to be greatest for habitats closest to the potential release location.
	Filter Feeders

Summary of Potential Impacts to Other Habitats and Communities	
	Hydrocarbon exposure may occur to offshore filter feeding communities (e.g. communities on hard substrate associated with the Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF and Continental Slope Demersal Fish Communities KEF or other locations as identified in Section 4.7.5), depending on the depth of the entrained/dissolved hydrocarbons. Exposure to entrained/dissolved aromatic hydrocarbons (≥400 ppb) has the potential to result in lethal or sublethal toxic effects. Sublethal impacts, including mucus production and polyp retraction, have been recorded for gorgonians exposed to hydrocarbon (White et al. 2012). Any impacts may result in localised long-term effects to community structure and habitat. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to filter feeders within the EMBA, with impacts predicted to be greatest for habitats closest to the potential release location.
Mainland and Islands (Nearshore Waters)	***Open Water – Productivity/Upwelling*** Nearshore waters and adjacent offshore waters surrounding the offshore islands (e.g. Montebello/ Barrow/Lowendal Islands Group) 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 sublethal 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, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to plankton populations within the EMBA.
	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 sublethal impacts from exposure to hydrocarbons, particularly if a spill coincides with spawning seasons or reaches nursery areas close to the shore (e.g. seagrass and mangroves) (ITOPF 2011a). 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 event of a major spill, there is potential for entrained or dissolved hydrocarbons to occur in the surface water layers above threshold concentrations in nearshore waters, including Montebello/Barrow/Lowendal Islands Group, Pilbara Southern and Northern Islands Groups, Ningaloo Coast, and the Muiron Islands. This has the potential to result in lethal and sublethal impacts to a portion of fish larvae in areas contaminated above impact thresholds, 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 the Deepwater Horizon 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). Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to spawning fish and/or nursery areas within the EMBA, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to key spawning periods and locations.
	Non-biogenic Reefs The reef communities fringing the Pilbara region (e.g. Pilbara islands) may be exposed to dissolved or entrained hydrocarbons (at or above threshold concentrations), and consequently exhibit lethal or sublethal impacts resulting in partial or total mortality of keystone sessile benthos, particularly hard corals; thus, potential community structural changes to these shallow, nearshore benthic communities may occur. If these reefs are exposed to entrained or dissolved hydrocarbons, impacts are expected to result in localised long-term effects. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to non-biogenic reefs within the EMBA.
	Filter Feeders

<table>
<tr><th colspan="2">Summary of Potential Impacts to Other Habitats and Communities</th></tr>
<tr><td></td><td>Hydrocarbon exposure to filter feeding communities (e.g. Montebello Islands) may occur, depending on the depth of the entrained and dissolved aromatic hydrocarbons. See discussion above on potential impacts.

Nearshore filter feeders that are present in shallower water <20 m may potentially be impacted by entrained hydrocarbon through lethal/sublethal effects (see discussion for Offshore Filter Feeders). Nearshore filter feeder communities identified in the Dampier Archipelago may be exposed to hydrocarbons. Such impacts may result in localised, long term effects to community structure and habitat.

Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to filter feeders within the EMBA.</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 oil.

Potential impacts may occur due to surface hydrocarbon contact with intertidal areas, including sandy shores, mudflats and rocky shores, as listed in Table 6-23. Hydrocarbons at sandy shores are incorporated into fine sediments through mixing in the surface layers from wave energy, penetration down worm burrows and root pores (IPIECA 2000). Hydrocarbons in the intertidal zone can adhere to sand particles; however, high tide may remove some or most of the hydrocarbons back out of the sediments. Typically, hydrocarbons are only incorporated into the surface layers to a maximum of 10 cm (ITOPF 2000). It is predicted that a number of sandy shores along the coastline may have accumulated hydrocarbons ≥100 g/m^2 (see Table 6-23). As described earlier, accumulated hydrocarbons ≥100 g/m^2 could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat. The persistence of the hydrocarbons will depend on the wave exposure but can be months to years.

The impact of oil on rocky shores largely depends on the incline and energy environment. On steep/vertical rock faces on wave-exposed coasts, there is likely to be no impact from a spill event. However, a gradually sloping boulder shore in calm water can potentially trap large amounts of oil (IPIECA 2000). The impact of the spill on marine organisms along the rocky coast will depend 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. The location of rocky shores where impacts are predicted are listed in Table 6-23.

Intertidal mudflats are susceptible to potential impacts from hydrocarbons, as they are typically low-energy environments and therefore trap oils. Intertidal mudflats have been identified in the EMBA along the Ningaloo coast (see Table 6-23). The extent of oiling is influenced by the neap and spring tidal cycle, and seasonal highs and lows that affect mean sea level. Potential impacts to tidal flats include heavy accumulations covering the flat at low tide; however, it is unlikely that oil will penetrate the water-saturated sediments. However, oil can penetrate fine sediments through animal burrows and root pores. It has been demonstrated that infaunal burrows allow hydrocarbons to enter subsurface sediments, where it can be retained for months.

The toxicity of stranded surface hydrocarbons and the in-water toxicity of the entrained or dissolved hydrocarbons reaching the shorelines will determine impacts to marine biota such as sessile barnacle species and/or mobile gastropods and crustaceans such as amphipods. Lethal and sublethal impacts may be expected where the entrained or dissolved hydrocarbon concentration threshold is >400 ppb. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to shorelines within the EMBA.</td></tr>
<tr><td>Key Ecological Features</td><td>Key Ecological Features

KEFs potentially impacted by the hydrocarbon spill from a loss of well containment event are detailed in Section 4.7.5. Although these KEFs are primarily defined by seabed geomorphological features, they can indicate a potential for increased biological productivity and, therefore, ecological significance.

The consequences of a hydrocarbon spill from a loss of well containment event are predicted to result in moderate impacts to values of the KEFs affected (for the values of each KEF, see Section 4.7.5). Potential impacts include contamination of sediments, impacts to benthic sediment fauna and associated impacts to demersal fish populations, and reduced biodiversity as described above and below. Most KEFs within the EMBA have relatively broad-scale distributions and are unlikely to be significantly impacted. KEFs within the EMBA that are not associated with broad-scale distributions (i.e. Glomar Shoal, and Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals). Glomar Shoal is predicted to be contacted by dissolved hydrocarbons, while Rowley Shoals is only predicted to be contacted at low probabilities, and by accumulated shoreline hydrocarbons.</td></tr>
</table>

Summary of Potential Impacts to Other Habitats and Communities	
	Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major long-term impacts to at Rankin Bank and Glomar Shoal, with lower consequence severity predicted for Rowley Shoals given its increased distance from the potential release location. No significant impacts are predicted to other KEFs within the EMBA (i.e. consequence of no lasting effect).

Summary of Potential Impacts to Water Quality	
Setting	***Aspect***
All Settings	***Open Water – Water Quality*** Water quality would be affected due to hydrocarbon contamination above impact thresholds. These are defined by the EMBA descriptions for each of the entrained and dissolved hydrocarbon fates and their predicted extent. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to water quality within the EMBA, with impacts predicted to be greatest for areas closest to the potential release location.

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 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 hydrocarbon would form droplets that would be transported into the water column to the surface (i.e. transported away from the seabed). As a result, the extent of potential impacts to the seabed area at and surrounding the release site would be largely 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, as hydrocarbons in sediments typically undergo slower weathering and degradation (Diercks et al. 2010, Liu et al. 2012). There is the potential for floating and entrained hydrocarbons to sink following extensive weathering and adsorption of sediment particles, which may result in the deposition of hydrocarbons to the seabed in areas distant from the release location. Such hydrocarbons are expected to be less toxic due to the weathering process. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in slight, short-term impacts to offshore sediment quality within the EMBA, with impacts predicted to be greatest for areas closest to the potential release location.
Mainland and Islands (Nearshore waters)	***Marine Sediment Quality*** Entrained and dissolved hydrocarbons (at or above the defined thresholds) are predicted to potentially contact shallow, nearshore waters of identified islands and mainland coastlines. Hydrocarbons may accumulate (at or above the ecological threshold) at a range of nearshore receptors (refer to Table 6-23). Such hydrocarbon contact may lead to reduced marine sediment quality by several processes, such as adherence to sediment and deposition shores or seabed habitat. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to sediment quality within the EMBA, with impacts predicted to be greatest for areas closest to the potential release location.

Summary of Potential Impacts to Air Quality
A hydrocarbon release during a loss of well containment has the potential to result in short-term reduction in air quality. There is potential for human health effects on workers in the immediate vicinity of atmospheric emissions. The ambient concentrations of VOCs released from diffuse sources is difficult to accurately quantify, although their behaviour and fate is predictable in open offshore environments, as VOC emissions disperse rapidly by meteorological factors such as wind and temperature. VOC emissions from a hydrocarbon release in such environments are rapidly degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals. Given the Remote likelihood of occurrence of a loss of well containment, the temporary nature of any VOC emissions (from either gas surfacing or weathering of liquid hydrocarbons from a loss of well containment), the predicted behaviour and fate of VOCs in open offshore environments, and the significant distance from the Operational Area to

Summary of Potential Impacts to Air Quality
the nearest sensitive airshed (town of Dampier ~119 km away), a worst-case hydrocarbon spill scenario has the potential to result in minor, short-term impacts to air quality within the EMBA, with impacts predicted to be greatest for areas closest to the potential release location.

Summary of Potential Impacts to Protected Areas
The quantitative spill risk assessment results indicate that the open-water environment protected within a number of Commonwealth AMPs (refer to Table 6-23) may be affected by released hydrocarbons in the event of a loss of well containment. In the Remote likelihood of a major spill occurring, entrained 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. Impact on the protected areas is discussed in the sections above for ecological values and sensitivities, and below for socioeconomic values. Additionally, such hydrocarbon contact may alter stakeholder understanding and/or perception of the protected marine environment, given these represent areas are largely unaffected by anthropogenic influences and contain biologically diverse environments.

Summary of Potential Impacts to Socioeconomic Values	
Setting	***Receptor Group***
Offshore	***Fisheries – Commercial*** A hydrocarbon release during a loss of well containment event has the potential to result in direct impacts to target species of Commonwealth and State fisheries within the defined EMBA (refer Table 4-9). Lethal and sublethal effects may impact localised populations of targeted species within the EMBA for entrained/dissolved hydrocarbons (≥400 ppb). However, entrained hydrocarbons are likely to be confined in the upper water column; therefore, demersal species are less likely to be exposed to hydrocarbons than pelagic species. A major loss of hydrocarbons from the Petroleum Activities Program may also lead to an exclusion of fishing from the spill-affected area for an extended period. 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 its efficacy depends on 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 seafood contamination 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 minor economic impacts to affected commercial fishing operators. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major, long-term impacts to commercial fisheries within the EMBA and socio-cultural EMBA, particularly for pelagic fisheries and fisheries with most of their effort focused within the EMBA (e.g. Pilbara Demersal Scalefish Managed Fishery and Mackerel Managed Fishery). Potential impacts to inshore fisheries are discussed in the Mainland and Islands (nearshore) impacts discussion below, and the impact assessment relating to spawning is discussed above.
	Tourism including Recreational Activities Recreational fishers predominantly target large 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 peak activity between April and October (Smallwood et al. 2011) for the Exmouth region. Limited recreational fishing takes place in the offshore waters of the Operational Area. Impacts on species that are recreationally fished are described above under Summary of Potential Impacts to Other Species. A major loss of hydrocarbons from the Petroleum Activities Program may lead to exclusion of marine nature-based tourist activities, 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, based on the perception of hydrocarbon spills and associated impacts. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in moderate, medium-term impacts to tourism and recreation within the EMBA and socio-cultural EMBA.

<table>
<tr><th colspan="2">Summary of Potential Impacts to Socioeconomic Values</th></tr>
<tr><td></td><td>Offshore Oil and Gas Infrastructure
A hydrocarbon release during a loss of well containment event has the potential to result in disruptions to production at existing petroleum facilities (platforms and FPSOs), as well as activities such as drilling and seismic exploration. For example, facility water intakes for cooling and fire hydrants could be shut off if contacted by floating hydrocarbons, which could in turn lead to the temporary cessation of production activities. Spill exclusion zones established to manage the spill could also prohibit access for activity support vessels 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 facilities are:
• NRC (operated by Woodside): overlapping the Operational Area (32 km from the Okha FPSO) – predicted to be contacted by floating hydrocarbons
• Angel Facility (operated by Woodside): overlapping the Operational Area (20 km from the Okha FPSO) – predicted to be contacted by floating hydrocarbons
• GWA (operated by Woodside): 11 km from the Operational Area
• Reindeer (operated by Santos): 45 km from the Operational Area.
Operation of these facilities is likely to be affected in the event of a well blowout spill. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in slight, short-term impacts to oil and gas industry within the EMBA.</td></tr>
<tr><td>Submerged Shoals</td><td>Tourism and Recreation
A hydrocarbon release during a loss of well containment event has the potential to result in a temporary prohibition on charter boat recreational fishing/diving and any other marine nature-based tourism trips to Rankin Bank, Glomar Shoal and Rowley Shoals. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in moderate, medium-term impacts to tourism and recreational activities within the EMBA and socio-cultural EMBA.</td></tr>
<tr><td>Mainland and Islands (Nearshore Waters)</td><td>Fisheries – Commercial
<u>Nearshore Fisheries and Aquaculture</u>
In the event of a loss of well containment, there is the possibility that target species in some areas used by a number of state fisheries could be affected, including wild oysters in the Pearl Oyster Managed Fishery that are within the EMBA and several west coast fisheries (refer to Table 4-9 for fisheries within the wider EMBA). Targeted fish, prawn, mollusc and lobster species and pearl oysters could experience sublethal stress, or in some instances mortality, depending on the concentration and duration of hydrocarbon exposure and its inherent toxicity.
<u>Prawn Managed Fisheries</u>
In the event of a major spill, the modelling indicated the entrained and dissolved EMBA may extend to nearshore waters, including the actively fished areas of the designated Onslow Prawn Managed Fishery, Exmouth Gulf Prawn Managed Fishery, Broome Prawn Managed Fishery, Nickol Bay Prawn Managed Fishery, and the Shark Bay Prawn and Scallop Managed Fishery, and managed prawn nursery areas. Note: Most of the demarcated area for the prawn managed fishery in the Exmouth Gulf is outside the EMBA.
Prawn habitat usage 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 have the potential to impact prawn stocks. For example, juvenile banana prawns are found almost exclusively in mangrove-lined creeks (Rönnbäck et al. 2002), whereas juvenile tiger prawns are most abundant in areas of seagrass (Masel and Smallwood 2000). Adult prawns also inhabit coastline areas but tend to move to deeper waters to spawn. In the event of a major spill, a range of subtidal habitats that support juvenile prawns may be exposed to hydrocarbons above impact thresholds, including:
• Montebello Islands
• Barrow Island
• Lowendal Islands
• Pilbara Northern, Middle, and Southern Island Groups
• Shark Bay
• Ningaloo Coast.
Localised loss of juvenile prawns in the worst spill-affected areas is possible. Whether lethal or sublethal effects occur will depend on duration of exposure, hydrocarbon concentration and</td></tr>
</table>

Summary of Potential Impacts to Socioeconomic Values	
	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. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in major, long-term impacts to commercial fisheries within the EMBA and socio-cultural EMBA.
	Tourism and Recreation In the event of a major spill, the nearshore waters of offshore islands and reefs as well as the Ningaloo coast could be reached by entrained hydrocarbons and dissolved hydrocarbons and floating hydrocarbons at the socio-cultural threshold (1 g/m^2), depending on prevailing wind and current conditions. As these locations offer a number of amenities such as fishing, swimming and using beaches and surrounds, they have a recreational value for local residents and visitors. If a well blowout event resulted in hydrocarbon contact, there could be restricted access to beaches for a period of days to weeks, until natural weathering, tides, currents or oil spill response (e.g. shoreline clean-up if safe to do so) removes the hydrocarbons. In the event of a well blowout, tourists and recreational users may also avoid areas due to perceived impacts, including after the oil spill has dispersed. Typically, a hydrocarbon spill that results in visible slicks in coastal waters and on shorelines will disrupt recreational activities, particularly tourism and its supporting services. In the event of a well blowout, hydrocarbons may accumulate on shorelines (at or above a set threshold) (see Table 6-23 for the full list of receptors). As a result of potential accumulation on beaches, it is expected that there will be a temporary cessation of all marine-based tourism activities on the spill-affected coast and wider coastal area for a period of weeks or longer, until natural weathering or tides and currents remove the hydrocarbons or clean-up operations remove beached oil. There is the potential for stakeholder perception that this 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 perceptions regarding the spill (Oxford Economics 2010). Therefore, a worst-case hydrocarbon spill scenario has the potential to result in moderate, medium-term impacts to tourism and recreational activities within the EMBA and socio-cultural EMBA.
	Cultural Heritage A number of Underwater Cultural Heritage sites (including historic shipwrecks) have been identified in the vicinity of Operational Area. The spill modelling results do not predict surface slicks will contact any identified wrecks. However, shipwrecks occurring in the subtidal zone will be exposed to entrained/dissolved hydrocarbons, and marine life that shelter and take refuge in and around these wrecks may be affected by in-water toxicity of dispersed hydrocarbons. The consequences of such hydrocarbon exposure may include large fish species moving away, and/or resident fish species and sessile benthos such as hard corals exhibiting sublethal and lethal impacts (which may range from physiological issues to mortality). Entrained hydrocarbons above threshold concentrations (>400 ppb) and accumulated hydrocarbons above thresholds (>100 g/m^2) are predicted at the Montebello/Barrow/Lowendal islands, as well as floating hydrocarbons at the socio-cultural threshold (1 g/m^2). Artefacts, scatter and rock shelters are on land above the high water mark on Barrow and Montebello islands; therefore, no contact by surface or accumulated hydrocarbons is predicted for these areas. Within the wider EMBA are several designated heritage places (Section 4.6.1). These places are also covered by other designations such as World Heritage Area. Potential impacts are discussed in the sections above.

MEE-01 Loss of Well Containment – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-01; refer to Figure 6-7, Figure 6-8, and Figure 6-9 for bowtie diagrams.

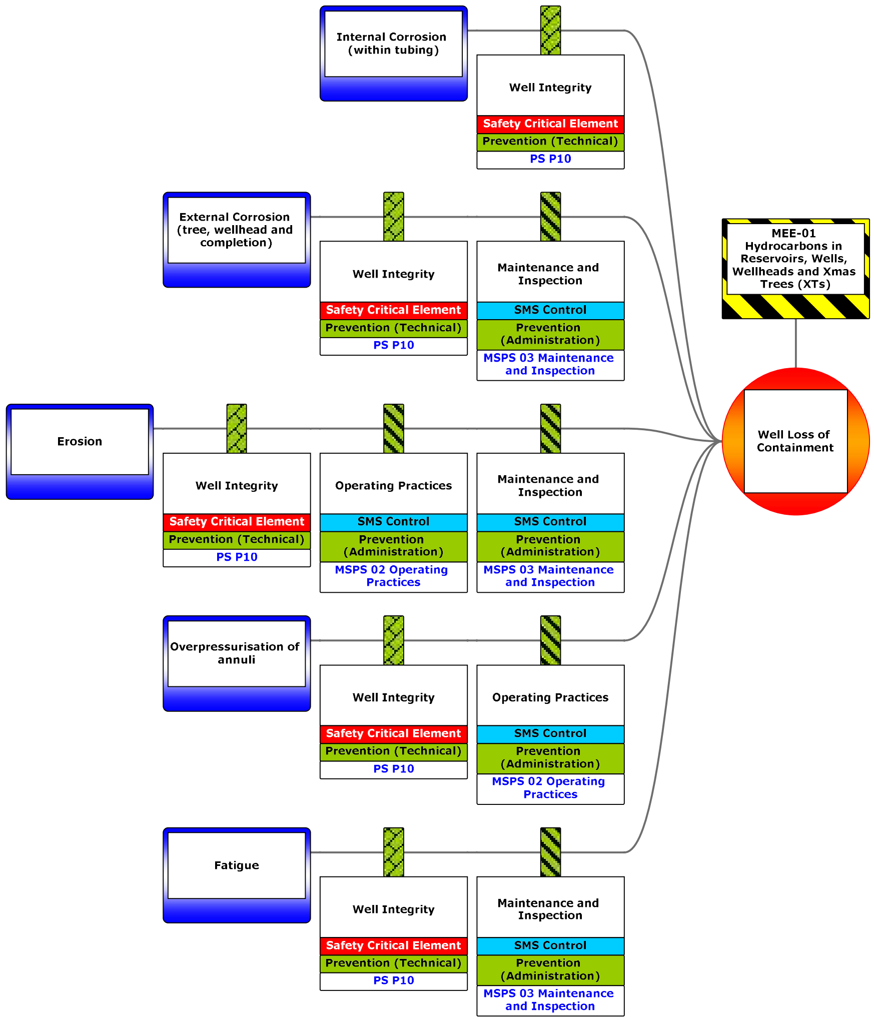

Figure 6-7: MEE-01 Wells Loss of Containment (Causes 1–5)

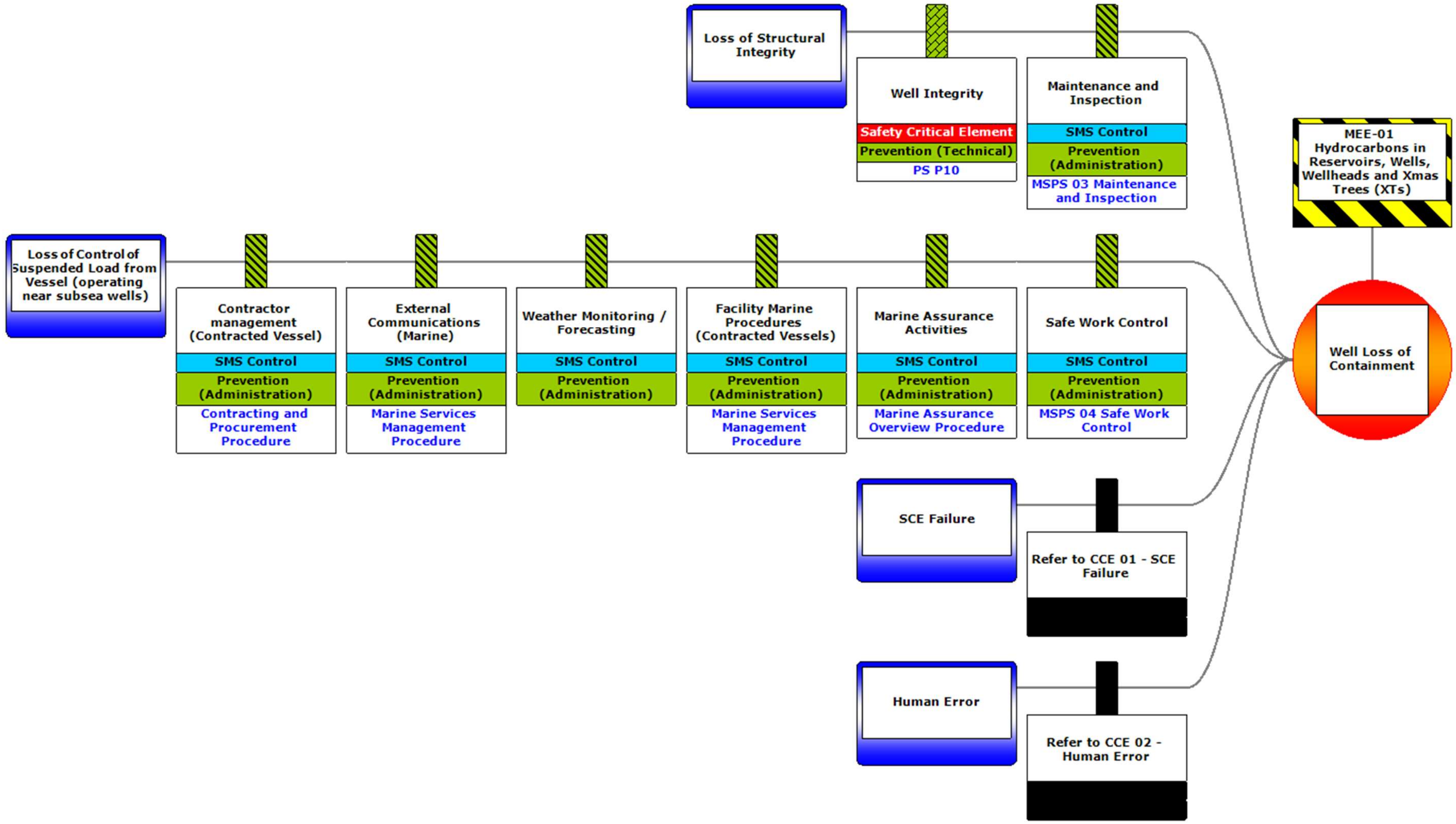

Figure 6-8: MEE-01 Wells Loss of Containment (Causes 6–9)

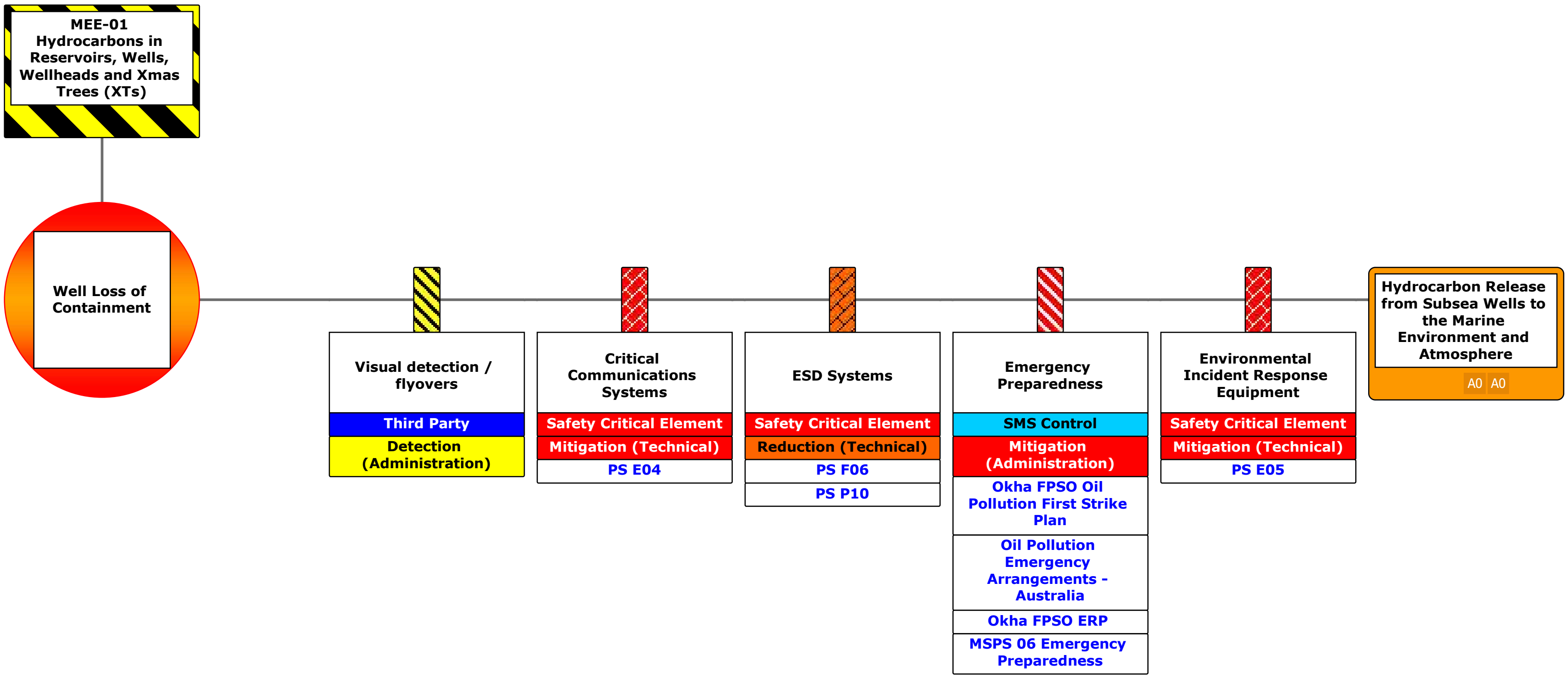

Figure 6-9: MEE-01 Wells Loss of Containment (Outcomes)

MEE-01 Loss of Well Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain well mechanical integrity to contain reservoir fluids within the well envelope to avoid a MEE.	P10 – Wells	Prevention (Technical)	Yes **C 12.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate response to accidents and emergencies.	E04 – Safety Critical Communication	Mitigation (Technical)	Yes **C 12.2**
Engineering Controls	Maintain safety instrumented system (safety instrumented functions and emergency shutdown actions) to detect and respond to predefined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE.	F06 – Safety Instrumented System P10 – Wells	Reduction / Control (Technical)	Yes **C 12.3**
Emergency Response	Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 12.4**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP) to demonstrate that the risks to well integrity are managed in accordance with sound engineering principles, standards, specifications, and good oilfield practice. It describes the systems that are in place to ensure well design and integrity is managed for the well lifecycle, thus contributing to management of associated potential environmental	Okha FPSO Well Operations Management Plan	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted)	Yes **C 12.5**

MEE-01 Loss of Well Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	consequences of well integrity events.			
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for Okha FPSO to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks – describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP. Thus, contributing to management of associated potential environmental consequences of MAEs.	Okha FPSO Operations Safety Case	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 8.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections • M04 Safe Work Control • Management of Change – Assets Procedure (Temporary Equipment) • Marine Services Management Procedure • Marine Assurance Overview Procedure • Contracting and Procurement Procedure	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspection MSPS-04 Safe Work Control Management of Change – Assets Procedure (Temporary Equipment) Marine Services Management Procedure Marine Assurance Overview Procedure Contracting and Procurement Procedure ISSoW Manual	Prevention (Administration)	Yes – See Section 7

<table>
<tr><th colspan="5">MEE-01 Loss of Well Containment – Demonstration of ALARP
ALARP Control Measures</th></tr>
<tr><th>Hierarchy</th><th>Control / Barrier</th><th>SCE / Management System Reference</th><th>Type of Effect (Table 6-21)</th><th>Control Adopted</th></tr>
<tr><td></td><td>• Integrated Safe System of Work (ISSoW) Manual.</td><td></td><td></td><td></td></tr>
<tr><td>Emergency Response and Contingency Planning</td><td>Implement management systems to maintain:
• M06 – Emergency Preparedness
• Okha Emergency Response Plan
• Okha Oil Pollution First Strike Plan (Appendix H)
• Oil Pollution Emergency Arrangements – Australia.</td><td>Emergency Preparedness
Okha Emergency Response Plan (ERP)
Okha Oil Pollution First Strike Plan (Appendix H)
Oil Pollution Emergency Arrangements – Australia</td><td>Mitigation
(Administration)</td><td>Yes
Refer to Section 7 for a discussion around the ALARP assessment of controls related to hydrocarbon spill response.</td></tr>
<tr><td colspan="5">Risk-based Analysis</td></tr>
<tr><td colspan="5">For risks identified as MEEs, a more detailed risk-based bowtie analysis (as outlined in Section 2.7.3) was used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls were selected following hierarchy of control principles and consider independence of each barrier and their type of effect in controlling the hazardous event.
Application of Woodside's Risk Management Procedures and implementation of the WOMP ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:
• ongoing hazard identification, risk assessment and the identification of control measures
• ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability
• wells integrity codes and standards.
For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical PSs which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.
Bowtie analysis was undertaken to assess MEE-01; refer to Figure 6-7, Figure 6-8, and Figure 6-9 for bowtie diagrams.
A quantitative spill risk assessment was undertaken (refer to Section 6.8.1 for details of the method used).</td></tr>
<tr><td colspan="5">Company Values</td></tr>
<tr><td colspan="5">Corporate values require all personnel at Woodside to comply with appropriate policies, standards, procedures and processes while being accountable for their actions and holding others to account in line with the Woodside Compass. As detailed above, the Petroleum Activities Program will be undertaken in line with these policies, standards and procedures, which include suitable controls to prevent loss of well containment, and response if a loss of well containment occurs.</td></tr>
<tr><td colspan="5">Societal Values</td></tr>
<tr><td colspan="5">Due to the Petroleum Activities Program's proximity to sensitive receptors (e.g. Montebello Islands, Glomar Shoal, Rankin Bank, Dampier Archipelago) and the potential extent of the wider EMBA, the loss of well containment risk rating presents a Decision Type B in accordance with the decision support framework described in Section 2.6.1. Extensive consultation was undertaken for this program to identify the views and concerns of relevant stakeholders, as described in Section 5.
Woodside sent an activity Information sheet to all identified relevant stakeholders regarding the Petroleum Activities Program (Section 5 and Appendix F). Woodside consulted with AMSA and WA Department of Transport (DoT) on spill response strategies. In accordance with the MOU between Woodside and AMSA, a copy of the Okha Oil Pollution First Strike Plan (Appendix H) was provided to AMSA.</td></tr>
</table>

MEE-01 Loss of Well Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a very low likelihood unplanned hydrocarbon release as a result of a loss of well containment.

The principle of inherent safety and environmental protection is based on preventing the MEE (through design of well integrity) and ensuring the wells are operated within their design envelope (through operating practices) and assurance (through maintenance and inspection). If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory that can be released and by implementing remediation.

The controls in place for preventing and mitigating MEEs are specified and assured by implementing the Okha WOMP, SCE management procedures including technical performance standards for SCEs and Management System Performance Standards (MSPSs) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures, and implementation of the WOMP ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability
- wells integrity codes and standards.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with loss of well containment from Okha FPSO subsea wells are managed to ALARP.

Demonstration of Acceptability

Acceptability Statement

Loss of well containment has been evaluated as having a 'Moderate' risk rating. As per Section 2.6.3.1, Woodside considers 'Moderate' risk ratings as acceptable if ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations below.

Principles of ESD

Woodside has a strong history of exploration and development of oil and gas reserves in the North West of WA with an excellent environmental record, while providing revenue to State and Commonwealth Governments, returns to shareholders, jobs and support to local communities. Titles for oil and gas exploration are released based on commitments to explore with the aim of uncovering and developing resources. It is under the lease agreement that Woodside has determined the potential to develop the hydrocarbon fields for which acceptance of this EP is sought under the Environment Regulations.

Woodside has established a number of research projects in order to understand the marine environments in which they operate, notably in the Exmouth Region and the Kimberley Region, including Rankin Bank, Glomar Shoal, Enfield Canyon and Scott Reef. Where scientific data do not exist, Woodside assumes that a pristine natural environment exists and therefore, implements all practicable steps to prevent damage. Woodside's corporate values 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.

Internal Context

The Petroleum Activities Program is consistent with Woodside corporate policies, standards, procedures, processes and training requirements as outlined in the Demonstration of ALARP and EPOs, including:

- Woodside Health, Safety, Environment and Quality Policy (Appendix A)
- Woodside Risk Management Policy (Appendix A)
- The SCE technical performance standards developed and implemented for the Okha FPSO.

Demonstration of Acceptability
Oil spill preparedness and response strategies are considered applicable to the nature and scale of the risk and associated impacts of the response are considered 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) can be re-assessed in the unlikely event of hydrocarbon release with consideration of the conservation 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 SMP will consider assessment and monitoring in line with the affected receptors such as habitat and species, AMPs, fisheries. ***External Context – Societal Values*** Woodside recognises that its licence to operate from a regulator and societal perspective is based on historical performance, complying with appropriate policies, standards and procedures, and understanding the expectations of external stakeholders. External stakeholder consultation, outlined below, was undertaken prior to the Petroleum Activities Program: • consultation with AMSA and WA DoT on spill response strategies. In accordance with the MOU between Woodside and AMSA, a copy of the Okha Oil Pollution First Strike Plan (Appendix H) was provided to AMSA and DoT. • consultation with other relevant stakeholders (Section 5); stakeholder feedback was incorporated into this EP where appropriate. By providing hydrocarbon spill response measures that are commensurate with the risk rating, location and sensitivity of the receiving environment (including social and aesthetic values), Woodside believes that this addresses societal concerns to an acceptable level. ***Other Requirements (includes laws, policies, standards and conventions)*** The Petroleum Activities Program is consistent with laws, policies, standards and conventions, including: • accepted Safety Case (as per the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 • mutual aid memorandum of understanding for relief well drilling is in place • accepted WOMP as per the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011. • notification of reportable and recordable incidents to NOPSEMA, if required, in accordance with Section 7. • objectives in the Ningaloo management plans (Management Plan for Ningaloo Marine Park and Muiron Islands Marine Management Areas, Ningaloo Marine Park Management Plan) with regards to water quality, coral, shoreline and intertidal, macroalgal, seagrass, mangroves, seabirds and social and economic values.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 12 Well loss of containment risks to the environment limited to High through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 12.1** Maintain well mechanical integrity to contain reservoir fluids within the well envelope to avoid a MEE.	**PS 12.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical PSs to prevent environment risk related damage to SCEs for: • P10 – Wells to: – ensure that a well retains the mechanical integrity to contain reservoir fluids within the well envelope at all times to avoid a MEE. Including operate phase environmentally critical equipment for pressure containment, structures, monitoring and isolating	**MC 12.1** Records demonstrate implementation of SCE technical Performance Standard(s) and Safety Critical Element Management Procedure.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		systems associated with the well.	
	C 12.2 Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies.	**PS 12.2** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • E04 – Safety Critical Communications to: – allow effective Emergency Response (ER) communications in emergencies, including: o internal communications such as audible and visual warning systems and voice communications during emergency events o external communications such as voice communications to adjacent facilities, aircraft and vessels, and external incident control centres during emergency events.	Refer to **MC 12.1**
	C 12.3 Maintain Safety Instrumented System (safety instrumented functions and emergency shutdown actions) to detect and respond to predefined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE.	**PS 12.3** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System and P10 – Wells to together: – detect and respond to predefined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE.	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 12.4 Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).	**PS 12.4** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • E05 – Environmental Incident Response Equipment, including; – satellite tracking drifter buoy able to monitor spill movement – sufficient hydrocarbon spill response equipment for control and/or clean-up of liquid hydrocarbon spills to ocean – minimum equipment coverage, to maintain adequate spill response capability.	Refer to **MC 12.1**
	C 12.5 Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted WOMP to demonstrate that the risks to well integrity are managed in accordance with sound engineering principles, standards, specifications, and good oilfield practice. It describes the systems that are in place to ensure well design and integrity is managed for the well lifecycle, thus contributing to management of associated potential environmental consequences of well integrity events.	**PS 12.5** An accepted WOMP is implemented, and well integrity notification and reporting is undertaken in accordance with the Regulations (as applicable).	**MC 12.5** Acceptance letter from NOPSEMA demonstrates acceptance of the WOMP. Records demonstrate applicable NOPSEMA notification and reporting.
	C 12.6 Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009:	**PS 12.6** An accepted Safety Case is implemented, and safety notification and reporting is undertaken in accordance with the Regulations (as applicable).	**MC 12.6** Acceptance letter from NOPSEMA demonstrates acceptance of the Safety Case. Records demonstrate applicable NOPSEMA notification and reporting.

<table>
<tr><th colspan="4">Environmental Performance Outcomes, Standards and Measurement Criteria</th></tr>
<tr><th>Outcomes</th><th>Controls</th><th>Standards</th><th>Measurement Criteria</th></tr>
<tr><td rowspan="3"></td><td>• Accepted Safety Case for the Okha FPSO to:
– identify hazards that have the potential to cause a MAE
– detail assessment of MAE risks
– describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP.
Thus, contributing to management of associated potential environmental consequences of MAEs.</td><td></td><td></td></tr>
<tr><td>C 8.5
Refer Section 6.7.1</td><td>PS 8.5
Refer Section 6.7.1</td><td>MC 8.5
Refer Section 6.7.1</td></tr>
<tr><td>Mitigation – hydrocarbon spill response</td><td colspan="2">Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.</td></tr>
</table>

6.8.4 Unplanned Hydrocarbon Release: Subsea Equipment Loss of Containment (MEE-02)

Context		
Flowline and Risers – Section 3.5.3 Subsea Infrastructure– Section 3.5.3 Subsea Inspection, Maintenance and Repair Activities – Section 3.10	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Release of hydrocarbons resulting from subsea equipment loss of containment.	-	X	X	X	X	X	X	B	C	2	M	LCS GP PJ RBA CV SV	Acceptable if ALARP	EPO 13

Description of Source of Risk

Background

The subsea production system comprises wells linked to subsea manifolds via flexible jumper and spool tie-ins. The subsea manifolds are then connected via flexible flowlines, which are tied back to the FPSO through five flexible risers (three production, one gas lift, one gas export). Gas is exported from the facility through a flexible riser from the RTM to a riser base where it connects to an 8-inch diameter flexible flowline, ~420 m long. The 8-inch flexible flowline connects to the Wanaea pipeline end (WANPE) module via a hydraulically operated subsea isolation valve. A 20 m rigid steel spool piece is located after the WANPE, which links to the 12-inch concrete coated WC GEL.

The hazard associated with this MEE is liquid hydrocarbons conveyed in Okha FPSO subsea equipment (flowlines, risers and associated equipment). The MEE associated with this hazard is loss of containment from the largest inventory subsea production flowline, resulting in a liquid hydrocarbon release to the environment. A loss of containment from a single riser does not result in a MEE due to a lower volume in the event of a spill, compared to a loss of containment from the largest inventory subsea production flowline.

A loss of subsea production flowline containment could occur because of:

- internal corrosion
- external corrosion
- overpressure
- under pressure
- equipment fatigue (risers and structural supports)
- pipeline stability and freespans
- anchor impact / dragging
- loss of control of suspended load from visiting vessel.

Escalation from other MEEs can cause subsea equipment loss of containment:

- loss of structural integrity (MEE-06) (Section 6.8.8)
- loss of marine vessel separation (MEE-07) (Section 6.8.9)
- loss of control of suspended load from facility lifting operations (MEE-08) (Section 6.8.10).

A number of common failure causes due to human error and SCE failures are presented in the generic Human Error and SCE failure bowties in Section 6.8.11.

Context

Subsea Equipment Loss of Containment – Credible Scenario

The worst-case credible hydrocarbon release scenario is rupture of the 8-inch production flowline, which holds the largest liquid hydrocarbon inventory within the Okha subsea system. This could result in a release of up to 414 m^3 of oil, based on an instantaneous full bore release, before wells are shut in within (conservatively) one hour of the rupture event. After the wells are shut in, it is assumed that remaining oil within the flowline continues to be released gradually to seabed for 72 hours. Rupture location is assumed to be near the Lambert Hermes manifold (LHM) which is the lowest point of the 8-inch production line. The subsea equipment loss of containment scenario parameters are summarised in Table 6-24.

Table 6-25: Summary of worst-case subsea loss of containment hydrocarbon release scenario

Scenario	Hydrocarbon	Duration (hrs)	Depth (m)	Latitude (WGS84)	Longitude (WGS84)	Total Oil Release Volume
Rupture of 8-inch production flowline (near LHM)	Cossack light crude	72	95	19° 30' 48.75" S	116° 28' 8.07" E	414 m^3

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in subsea system design and construction. In the company's recent history, it has not experienced any subsea integrity events that have resulted in significant environmental impacts. The Okha FPSO has never experienced a worst-case subsea loss of containment in its operational history.

Decision Type

Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications if the event is realised. To align with this decision type, a further level of analysis has been applied using risk-based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling. Company and societal values were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation.

The release of hydrocarbons as a result of subsea equipment loss of containment is considered a Major Environment Event (MEE-02). The hazard associated with this MEE is liquid hydrocarbons conveyed in Okha FPSO subsea equipment (flowlines, risers and associated equipment). Note that Woodside has assessed the environment consequence of a worst-case credible loss of containment from subsea equipment as 'C' as per the Woodside Risk Matrix. Woodside has also assessed the reputational and brand consequences associated with this release and concluded that the event results in a 'B' level consequence, and hence meets Woodside's definition of a MEE (refer to Section 2.7.2).

Quantitative Spill Risk Assessment

Spill modelling of a larger volume (773 m^3) of Cossack light crude, at the same location and depth in Table 6-24, was undertaken previously by RPS APASA, on behalf of Woodside, to determine the fate of hydrocarbon released in a worst-case credible subsea equipment loss of containment scenario. The modelled release volume (773 m^3) was based on rupture of both the 8-inch production flowline and 6-inch dual purpose flowline. Since undertaking this modelling, the 6-inch dual purpose line has been converted to gas lift. Hence, current worst-case credible hydrocarbon release scenario considers rupture of the 8-inch production flowline only. This previous modelling is considered appropriate and conservative to inform spill risk assessment for the current scenario outlined in Table 6-24.

Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volumes for all subsea loss containment scenarios.

Refer to Section 6.8.1 for quantitative spill risk assessment methodology and Section 6.8.1.1 for a description of Cossack light crude characteristics.

Likelihood

In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance, flowline marked on marine charts), the likelihood of a subsea loss of containment has been defined as Unlikely (2).

Consequence

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case subsea equipment loss of containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS,

Context
available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.3) and relevant literature and studies considering the effects of hydrocarbon exposure.

Consequence Assessment
Environment that May be Affected
Surface Hydrocarbons
The modelled surface hydrocarbons are forecast to drift down current of the release location with the trajectory dependent on prevailing wind and current conditions at the time and may extend up to 15 km from the release site. Modelling results indicate no contact with sensitive receptors by surface (floating) hydrocarbons above the EMBA impact threshold (10 g/m^2) or Socio-cultural EMBA threshold (1 g/m^2) at probabilities of 1% or greater.
Entrained Hydrocarbons
Modelling results indicate no contact with sensitive receptors by entrained hydrocarbons above impact the threshold (400 ppb) at probabilities of 1% or greater.
Dissolved Hydrocarbons
Modelling results indicate no contact with sensitive receptors by dissolved hydrocarbons above the impact threshold (400 ppb) at probabilities of 1% or greater.
Accumulated Hydrocarbons
Modelling results indicate no contact with sensitive receptors by accumulated shoreline hydrocarbons above the impact threshold (100 g/m^2) at probabilities or 1% of greater, with a maximum accumulated volume of <1 m^3 along all shoreline receptors.
Consequence Assessment Summary
Modelling of the credible worst-case hydrocarbon spill scenario that may arise from MEE-02 indicates that the spill will remain offshore with contact limited to the Ancient Coastline at 125 m Depth Contour KEF, which overlaps the Operational Area. The biological consequences of such a spill on identified open water sensitive receptors relate to the potential for moderate, medium-term impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill affected area. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01 (Section 6.8.3).

MEE-02 Subsea Equipment Loss of Containment – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-02; refer to refer to Figure 6-10, Figure 6-11, Figure 6-12, and Figure 6-13.

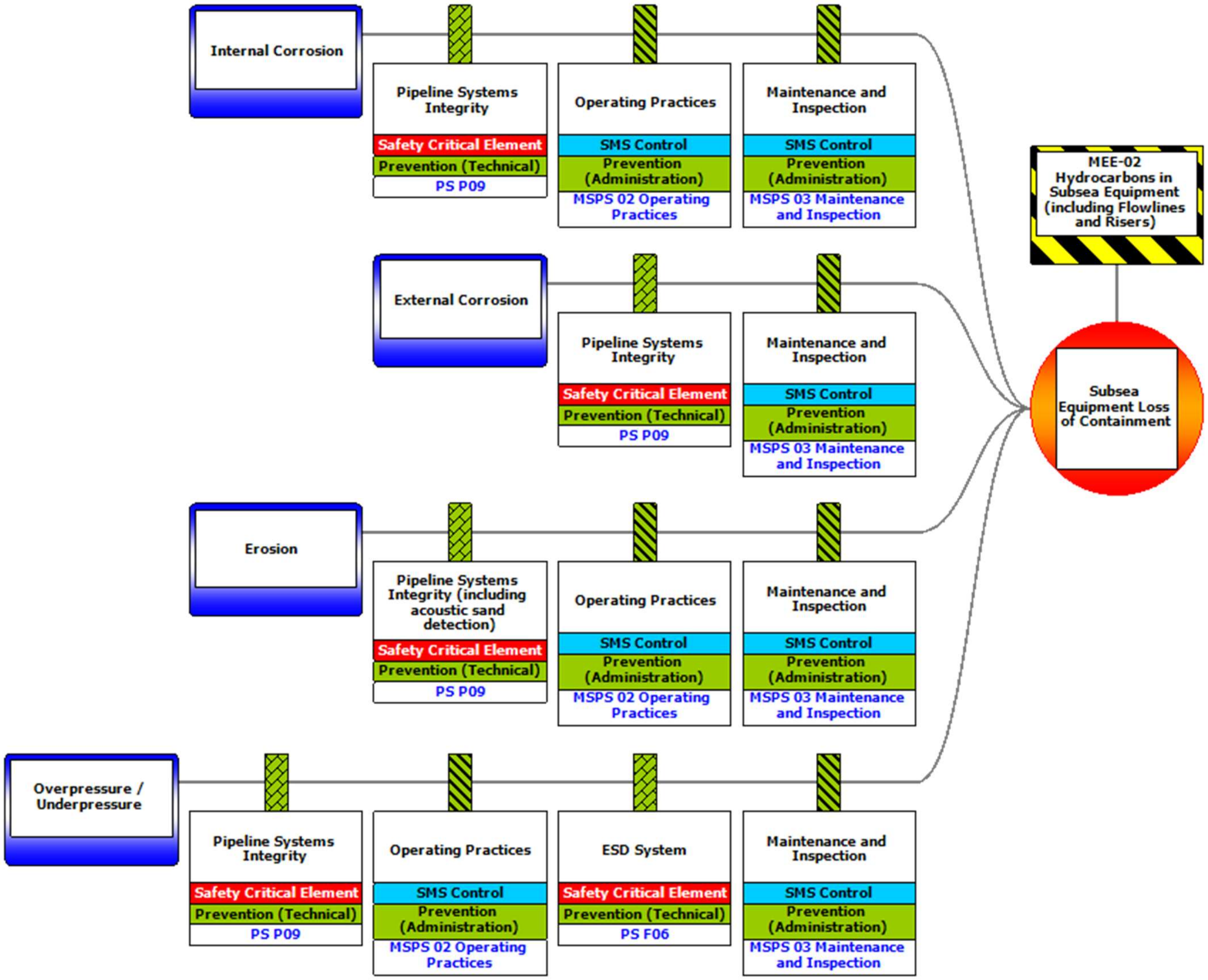

Figure 6-10: MEE-02 Subsea Equipment Loss of Containment (Causes 1–4)

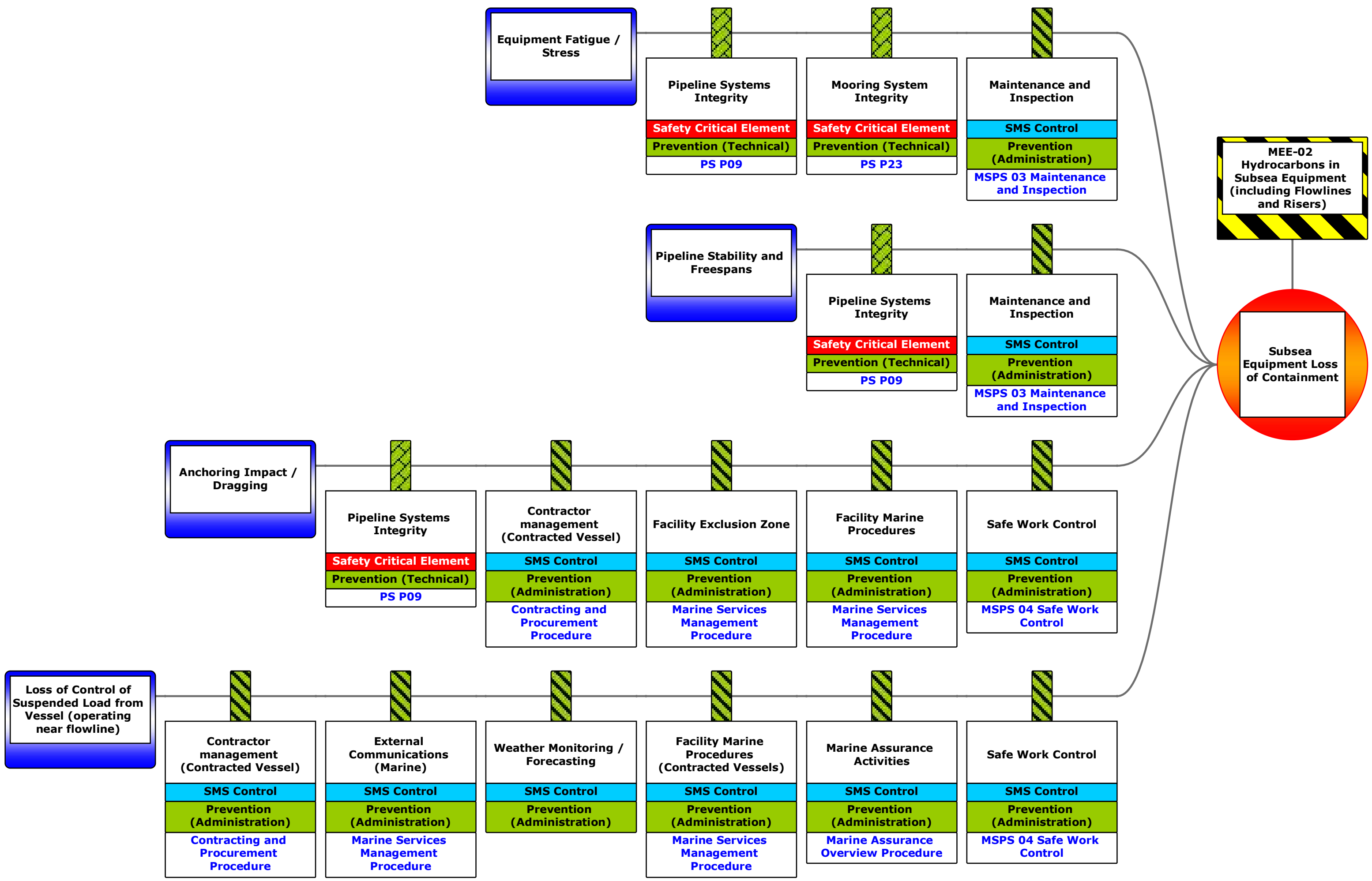

Figure 6-11: MEE-02 Subsea Equipment Loss of Containment (Causes 5–8)

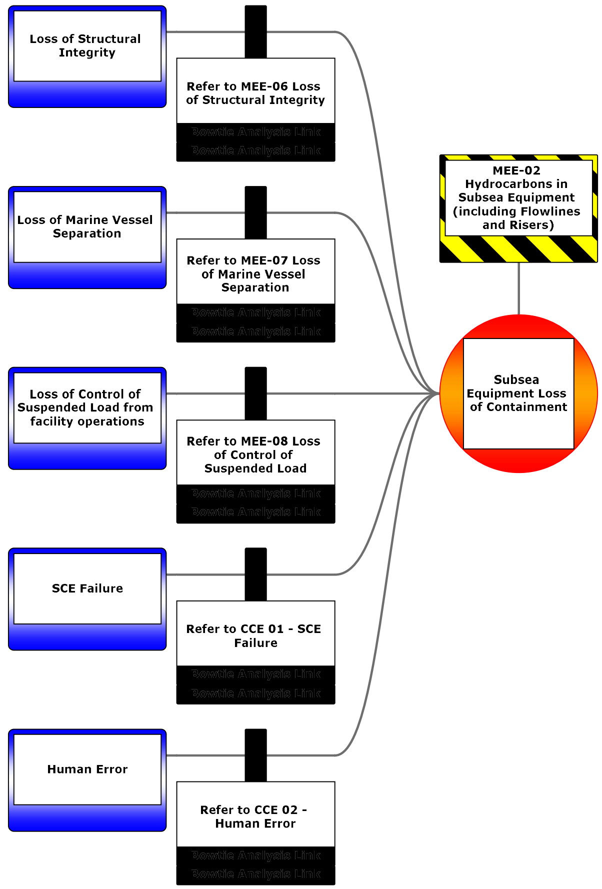

Figure 6-12: MEE-02 Subsea Equipment Loss of Containment (Causes 9–13)

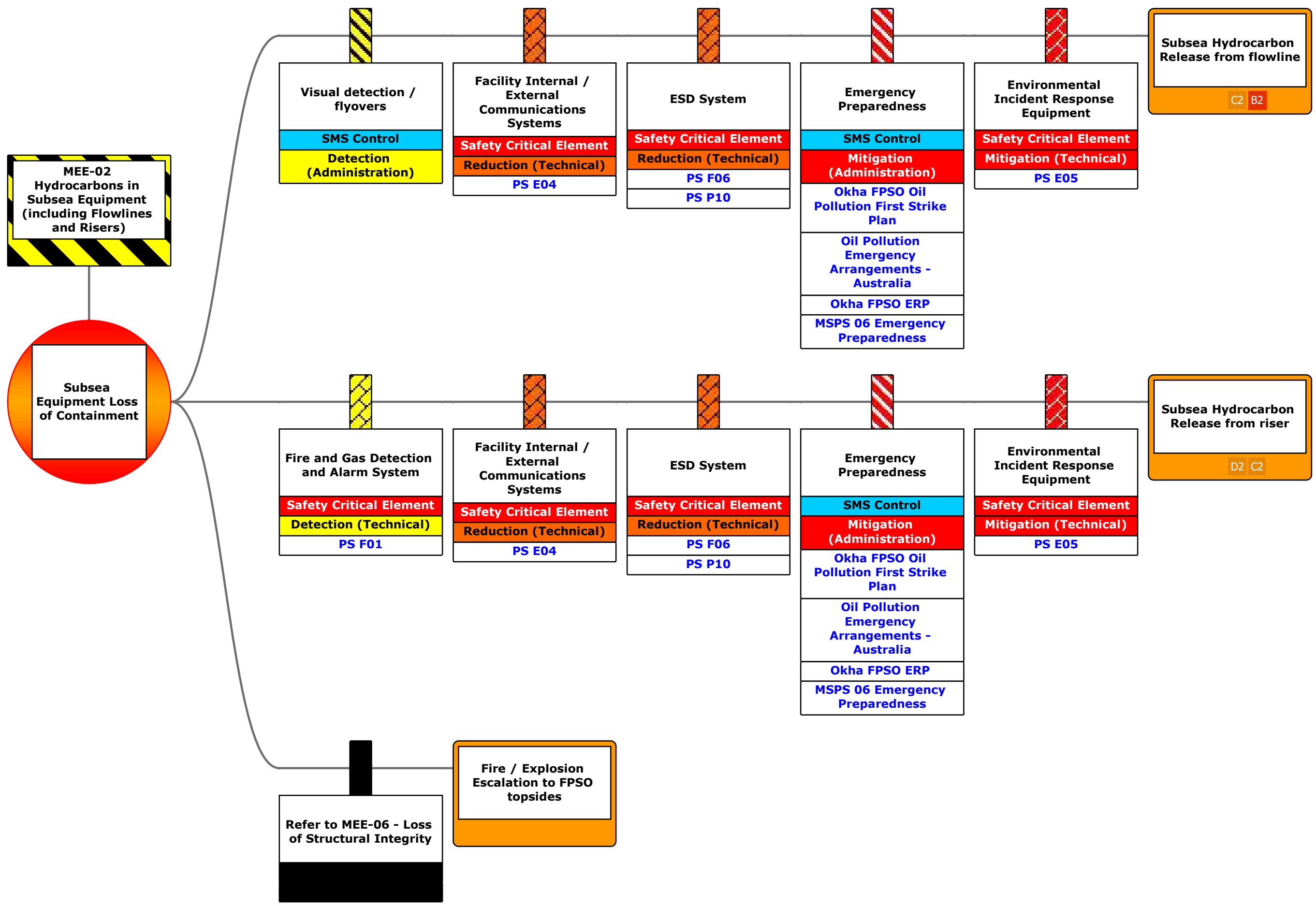

Figure 6-13: MEE-02 Subsea Equipment Loss of Containment (Outcomes)

MEE-02 Subsea Equipment Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain flowline, riser and hydrocarbon-containing infrastructure integrity to avoid a MEE.	P09 – Pipeline Systems P23 – Mooring Systems F06 – Safety Instrumented System	Prevention (Technical)	Yes **C 13.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies.	E04 – Safety Critical Communications	Mitigation (Technical)	Yes **C 12.2**
Engineering Controls	Maintain Fire and Gas Detection and Alarm Systems to facilitate prevention and response to fire or gas hazards.	F01 – Fire and Gas Detection and Alarm System	Detection (Technical)	Yes **C 13.2**
Engineering Controls	Maintain Safety Instrumented System (Safety Instrumented Functions and emergency shutdown actions) to detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition (e.g. through appropriate isolation of hazardous inventories) so as to prevent or mitigate the effects of a MEE.	F06 – Safety Instrumented System P10 – Wells	Reduction / Control (Technical)	Yes **C 12.3**
Emergency Response	Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 12.4**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha FPSO to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks and	Okha FPSO Safety Case	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**

MEE-02 Subsea Equipment Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	– describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP. Thus, contributing to management of associated potential environmental consequences of MAEs.			
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements. Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Yes **C 8.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections • M04 Safe Work Control • Marine Services Management Procedure • Marine Assurance Overview Procedure • Contracting and Procurement Procedure	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections MSPS-04 Safe work Control Marine Services Management Procedure Marine Assurance Overview Procedure Contracting and Procurement Procedure	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Emergency Response and contingency planning	Implement management systems to maintain: • M06 – Emergency Preparedness • Okha Emergency Response Plan	MSPS-06 Emergency Preparedness Okha Emergency Response Plan Okha Oil Pollution First Strike Plan (Appendix H)	Mitigation (Administration)	Yes – See Section 7 Refer to Appendix D for discussion around the ALARP

MEE-02 Subsea Equipment Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	• Okha Oil Pollution First Strike Plan (Appendix H) • Oil Pollution Emergency Arrangements – Australia • Contracting and Procurement Procedure	Oil Pollution Emergency Arrangements – Australia Contracting and Procurement Procedure		assessment of controls related to hydrocarbon spill response.

Risk Based Analysis

For risks identified as MEEs, a more detailed risk-based Bowtie Analysis (as outlined in Section 2.7.3), has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

Application of Woodside Risk Management Procedures, and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-02; refer to Figure 6-10, Figure 6-11, Figure 6-12, and Figure 6-13 for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer Section 6.8.1 for details of spill modelling methodology).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

Societal Values

Refer to Societal Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a low likelihood unplanned hydrocarbon release as a result of a worst-case loss of subsea equipment containment.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of subsea equipment integrity and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and Management System Performance Standards (MSPS) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures, and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

MEE-02 Subsea Equipment Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Given the controls in place to prevent and control loss of containment events and mitigate their consequences, alongside procedural controls, it is considered that MEE risks associated with loss of containment from subsea equipment are managed to ALARP.				

Demonstration of Acceptability
Acceptability Statement Subsea equipment loss of containment has been evaluated as having a 'Moderate' risk rating. As per Section 2.8.2, Woodside considers 'Moderate' risk ratings as acceptable if ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the considerations described for MEE-01 (Section 6.8.3), where considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 13 Subsea equipment loss of containment risks to the environment limited to High through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 13.1** Maintain flowline, riser and hydrocarbon-containing infrastructure integrity to avoid a MEE.	**PS 13.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P09 – Pipeline Systems • P23 – Mooring Systems • F06 – Safety Instrumented System to together: • maintain the minimum required mechanical and structural integrity to prevent loss of containment that may result in a MEE • detect and respond to pre-defined initiating conditions to protect mechanical integrity.	**MC 12.1**
	Refer to **C 12.2**	Refer to **PS 12.2**	Refer to **MC 12.1**
	Refer to **C 12.3**	Refer to **PS 12.3**	Refer to **MC 12.1**
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	C 13.2 Maintain Fire and Gas Detection and Alarm Systems to facilitate prevention and response to fire or gas hazards.	**PS 13.2** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for:	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		• F01 – Fire and Gas Detection and Alarm System; to continuously monitor and alert for fire events and significant gas accumulations, initiate actions to minimise event escalation, and support Emergency Response by providing status of situation.	
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.5 Unplanned Hydrocarbon Release: Topsides Loss of Containment (MEE-03)

Context		
Topsides – Section 3.5.1 Process Description – Section 3.6.2 Hydrocarbon and Chemical Inventories and Selection – Section 3.9	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Hydrocarbon release from topside process equipment to the marine environment and atmosphere.	-	-	X	X	X	X	X	B	D	1	M	LCS GP PJ RBA CV	Acceptable if ALARP	EPO 14
Hydrocarbon release from topsides non-process equipment to the marine environment.	-	-	X	X	X	X	X	B	D	1	M			

Description of Source of Risk

Background

The Okha FPSO has a range of topsides process and non-process equipment within 11 pre-assembled modules. Release of process (i.e. gas and crude) and non-process hydrocarbons (of which diesel is the largest inventory) from the Okha topsides has the potential to release moderate quantities of hydrocarbons to the marine environment. Topsides process and non-process hydrocarbon inventories are provided in Section 3.9.

The following causes could lead to loss of containment from the Okha FPSO topsides:

- internal corrosion
- external corrosion
- erosion
- overpressure
- low temperature
- fatigue/ overstress of topsides equipment
- rotating equipment failure/ uncontrolled transfer.

Escalation from other MEEs can cause topsides loss of containment:

- loss of structural integrity (MEE-06) (Section 6.8.8)
- loss of marine vessel separation (MEE-07) (Section 6.8.9)
- loss of control of suspended load from facility lifting operations (MEE-08) (Section 6.8.10).

A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in Section 6.8.11.

Topsides Loss of Containment – Credible Hydrocarbon Spill Scenarios

For a process release, the worst credible scenario is defined as the loss of the entire inventory of the HP separator, which holds a maximum isolatable inventory of 113.5 m^3 of crude oil. This scenario assumes a large borehole release (such as major rupture or failure) where the inventory would be released in less than 10 minutes, and assumes that only the isolatable inventory of the process equipment is released due to activation of the emergency shutdown systems, thus limiting further release of hydrocarbons.

Context
For a non-process release, the worst credible scenario is defined as the loss of the entire inventory of one diesel day tank, which holds a maximum inventory of 6 m^3 of diesel. Larger diesel inventories are stored on the Okha FPSO (refer Section 3.9) however with the exception of the diesel day tanks, all other diesel storage tanks are located below the main deck, and therefore not considered credible topsides loss of containment scenario.
Decision Type, Risk Analysis and ALARP Tools
Woodside has a good history of implementing industry standard practice in FPSO operation. In the company's 60-year history, it has not experienced any topsides integrity events that have resulted significant environmental impacts. The Okha facility has never experienced a worst-case topsides loss of containment in its operational history.
Decision Type
Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling (Section 6.8.1). Company values were also considered in the demonstration of ALARP and acceptability.
Note that Woodside has assessed the environment consequence of a worst-case credible loss of containment from topsides equipment as 'D' as per the Woodside Risk Matrix, which does not meet Woodside's definition of a MEE. However, topsides loss of containment has been retained for clarity and to articulate key control measures to control or prevent escalation to other MEEs.
Quantitative Spill Risk Assessment
Hydrocarbon spill modelling for a 724 m^3 release of processed crude oil as a result of an FPSO offtake system loss of containment (MEE-04) is discussed in Section 6.8.6. The results of this modelling can be considered to be a very conservative estimate of the worst-case topsides process loss of containment of the HP separator, which holds a maximum isolatable inventory of 113.5 m^3 of crude oil. The potential impacts of the topsides process release are therefore discussed in Section 6.8.6 (MEE-04).
Similarly, hydrocarbon spill modelling for a 105 m^3 release of diesel due to loss of marine vessel separation (MEE-07) is discussed in Section 6.8.9. The results of this modelling can be considered to be a very conservative estimate of the worst-case topsides non-process loss of containment of a diesel day tank, which holds 6 m^3 of diesel. The potential impacts of the topsides non-process release are therefore discussed in Section 6.8.9 (MEE-07).
Hydrocarbon Characteristics
Refer to Section 6.8.1.1 for both Cossack light crude and diesel characteristics.
Consequence
The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case topsides loss of containment. These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.3) and relevant literature and studies considering the effects of hydrocarbon exposure.
Likelihood
In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance), the likelihood of a worst-case topsides loss of containment has been defined as Highly Unlikely (1).

Consequence Assessment
Detailed assessment of the potential impacts from a hydrocarbon release from topside process and non-process equipment has been described in Section 6.8.6 (MEE-04) and Section 6.8.9 (MEE-07). Refer to Section 6.8.3 for a description of potential impacts.
Impacts from the credible worst-case hydrocarbon spill scenario that may arise from MEE-03 have been inferred from modelling outputs described in Section 6.8.6 (MEE-04) and Section 6.8.9 (MEE-07). These conservative modelling results indicate that the spill will remain offshore with contact limited to the Ancient Coastline at 125 m Depth Contour KEF and the Glomar Shoal KEF. The biological consequences of such a spill on identified open water sensitive receptors relate to the potential for minor, short-term impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill affected area. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01 (Section 6.8.3).

MEE-03 Topsides Loss of Containment – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-03; refer to Figure 6-14, Figure 6-15, Figure 6-16, and Figure 6-17 for bowtie diagrams.

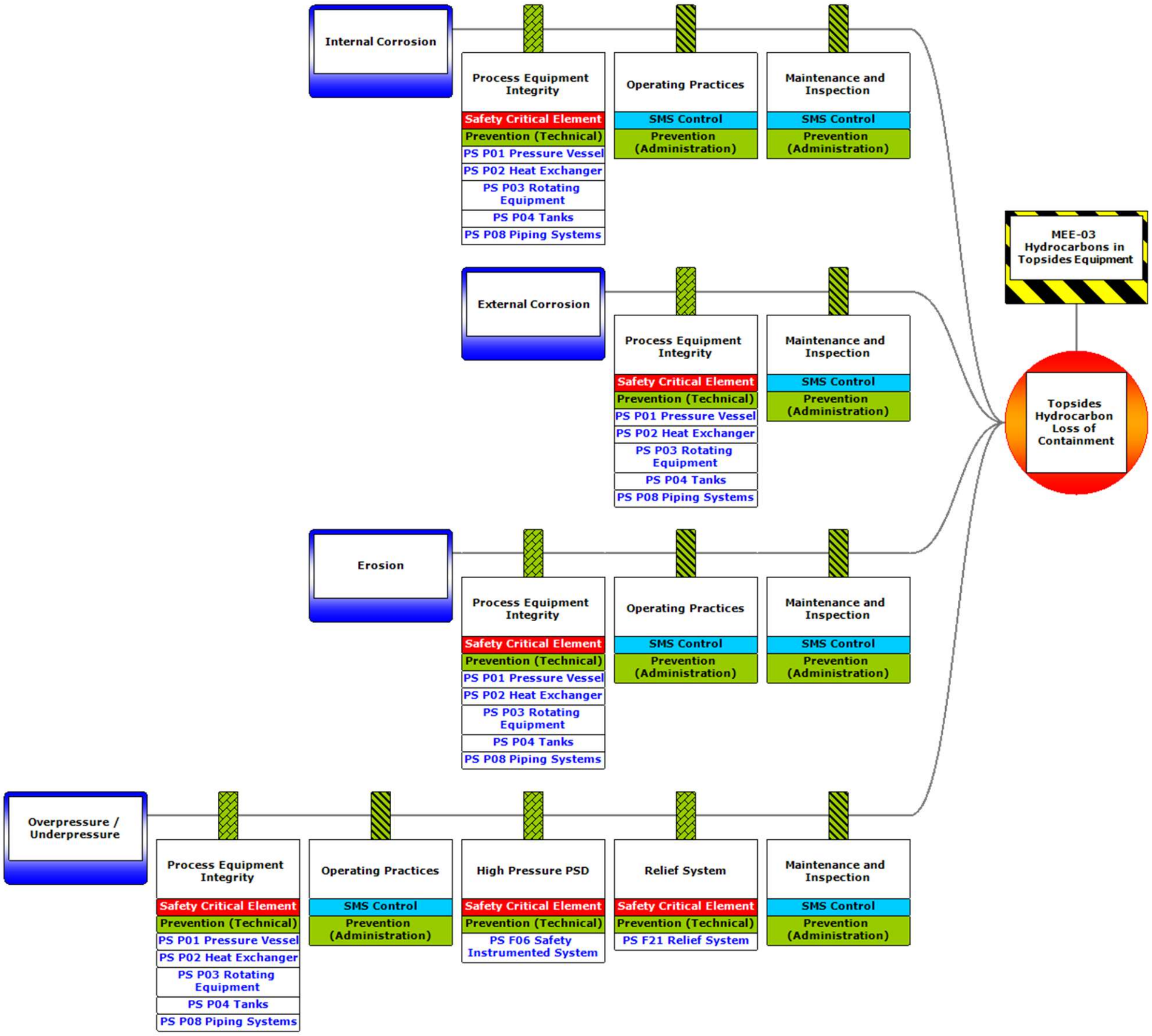

Figure 6-14: MEE-03 Topsides Loss of Containment (Causes 1–4)

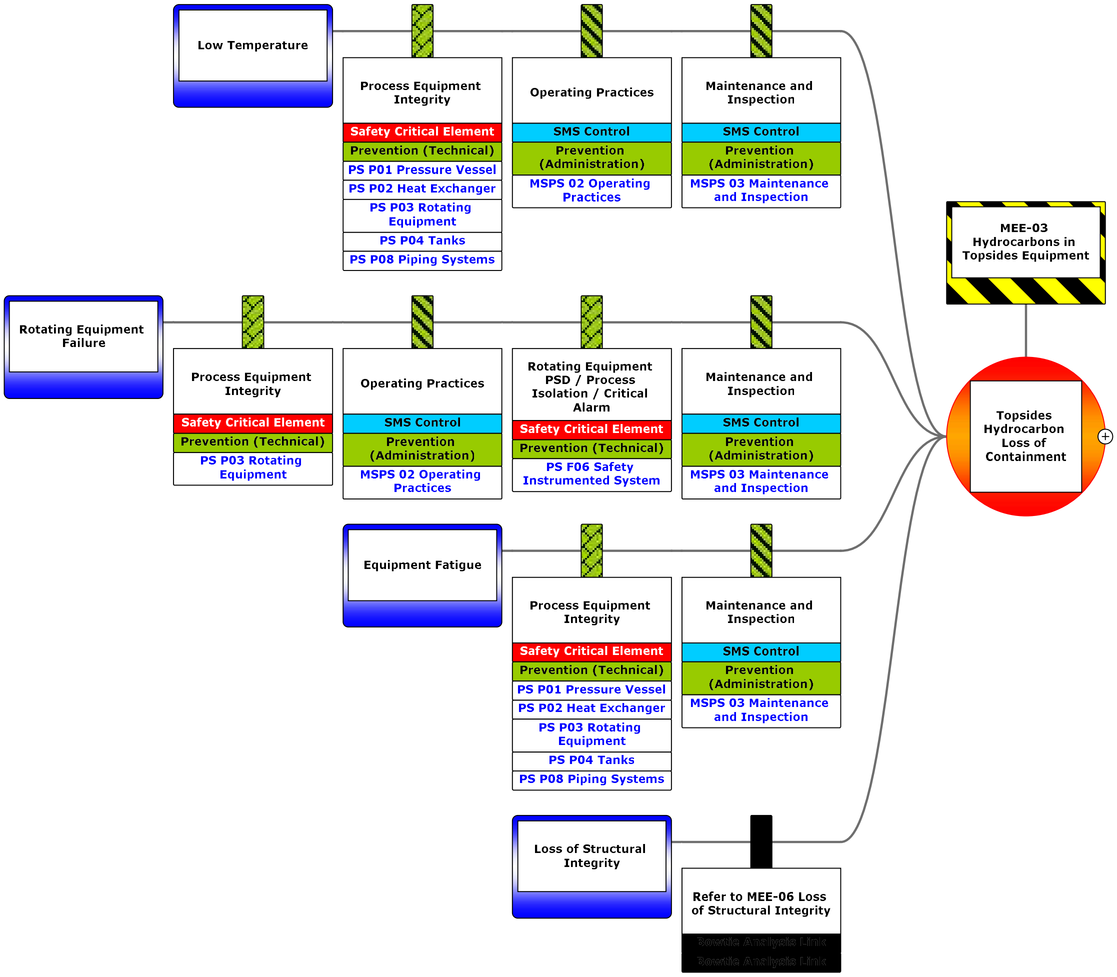

Figure 6-15: MEE-03 Topsides Loss of Containment (Causes 5–8)

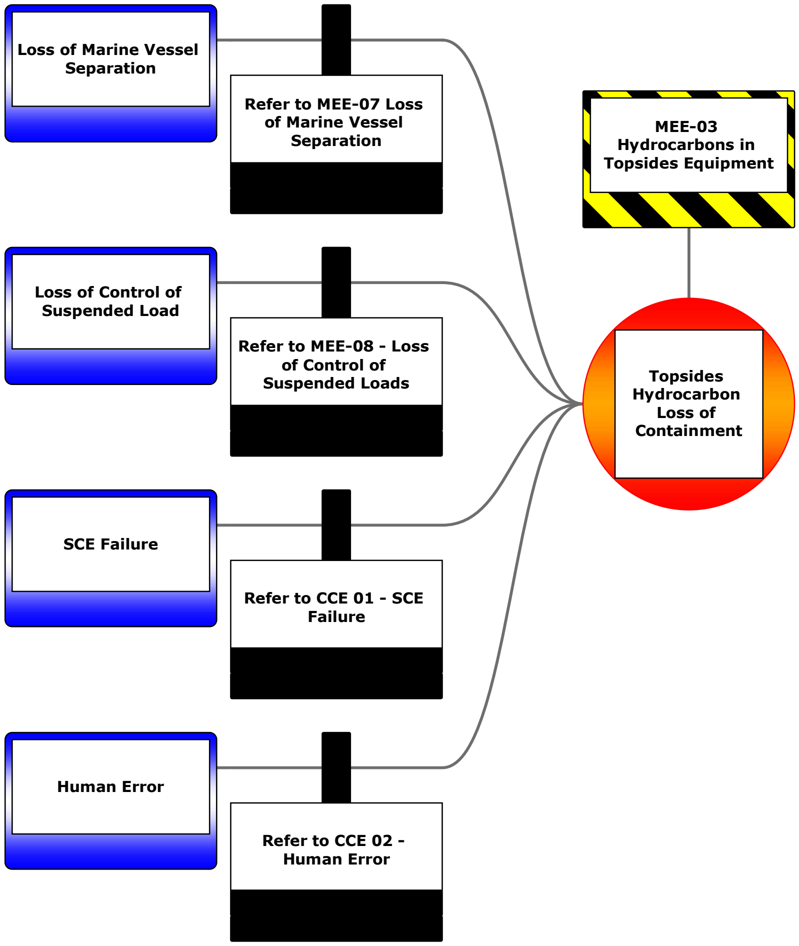

Figure 6-16: MEE-03 Topsides Loss of Containment (Causes 9–12)

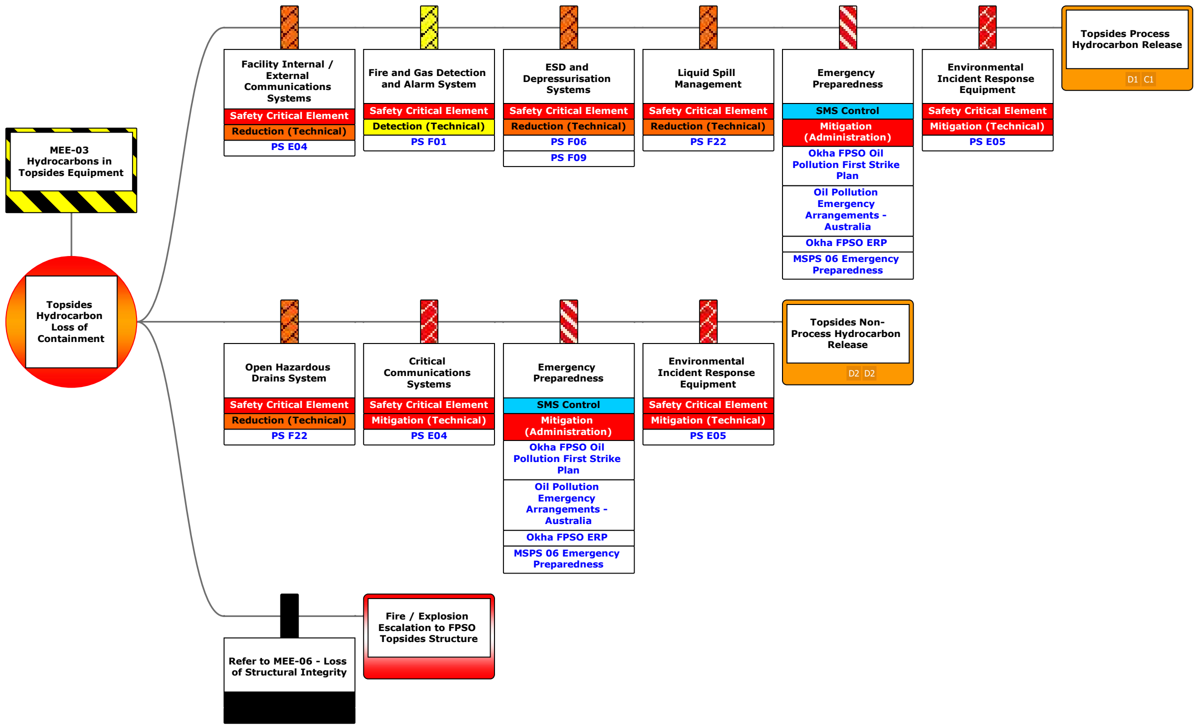

Figure 6-17: MEE-03 Topsides Loss of Containment (Outcomes)

MEE-03 Topsides Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain topsides hydrocarbon-containing infrastructure integrity.	P01 – Pressure Vessel P02 – Heat Exchanger P03 – Rotating Equipment P04 – Tanks P08 – Piping Systems	Prevention (Technical)	Yes **C 14.1**
Engineering Controls	Maintain Safety Instrumented Systems and Relief System to prevent hydrocarbon loss of containment in order to prevent a MEE.	F06 – Safety Instrumented System F21 – Relief Systems	Prevention (Technical)	Yes **C 14.2**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies.	E04 – Safety Critical Communications	Mitigation (Technical)	Yes **C 12.2**
Engineering Controls	Maintain Fire and Gas detection and Alarm Systems on Okha facility to facilitate prevention and response to fire or gas hazards.	F01 – Fire and Gas Detection and Alarm System	Detection (Technical)	Yes **C 13.3**
Engineering Controls	Maintain Safety Instrumented Systems (e.g. emergency shutdown and safety instrumented functions) system, Blowdown and Open Hazardous Drains system to isolate, remove and control hazardous inventories so as to mitigate the effects of a MEE/ prevent escalation to a MEE.	F06 – Safety Instrumented System F09 – Depressurisation (Blowdown); F22 – Open Hazardous Drains	Reduction / Control (Technical)	Yes **C 13.2**
Emergency Response	Maintain environmental incident response equipment to enact the Okha Oil	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C12.4**

MEE-03 Topsides Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	Pollution First Strike Plan (Appendix H).			
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha FPSO to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks – describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP. Thus, contributing to management of associated potential environmental consequences of MAEs.	Okha Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements. Good practice that operators identify, report and learn from unplanned release events. Supports	Yes **C 8.5**

<table>
<tr><th colspan="5">MEE-03 Topsides Loss of Containment – Demonstration of ALARP
ALARP Control Measures</th></tr>
<tr><th>Hierarchy</th><th>Control / Barrier</th><th>SCE / Management System Reference</th><th>Type of Effect (Table 6-21)</th><th>Control Adopted</th></tr>
<tr><td></td><td></td><td></td><td>compliance with regulatory reporting requirements.</td><td></td></tr>
<tr><td colspan="5">Management System Specific Measures: Key Standards or Procedures</td></tr>
<tr><td>Procedures and Administration</td><td>Implement management systems to maintain:
• M02 Operating Practices
• M03 Maintenance and Inspections
• Maintain Assets Procedure.</td><td>MSPS-02 Operating Practices
MSPS-03 Maintenance and Inspections
Maintenance of Assets Procedure</td><td>Prevention (Administration)</td><td>Yes – See Section 7 Implementation Strategy.</td></tr>
<tr><td>Emergency Response and contingency planning</td><td>Implement management systems to maintain:
• M06 – Emergency Preparedness
• Okha Emergency Response Plan
• Okha Oil Pollution First Strike Plan (Appendix H)
• Oil Pollution Emergency Arrangements – Australia.</td><td>MSPS 06 – Emergency Preparedness
Okha Emergency Response Plan
Okha Oil Pollution First Strike Plan (Appendix H)
Oil Pollution Emergency Arrangements – Australia</td><td>Mitigation
(Administration)</td><td>Yes – See Section 7
Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.</td></tr>
<tr><td colspan="5">Risk Based Analysis</td></tr>
<tr><td colspan="5">For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7.1) has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.
Application of Woodside Risk Management Procedures, and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:
• ongoing hazard identification, risk assessment and the identification of control measures
• ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.
For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.
Bowtie analysis was undertaken to assess MEE-03; refer to Figure 6-14, Figure 6-15, Figure 6-16, and Figure 6-17 for bowtie diagrams.
A quantitative spill risk assessment was undertaken (refer Section 6.8.1).</td></tr>
<tr><td colspan="5">Company Values</td></tr>
<tr><td colspan="5">Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).</td></tr>
<tr><td colspan="5">Societal Values</td></tr>
</table>

MEE-03 Topsides Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Refer to Societal Values in demonstration of ALARP for MEE-01 (Section 6.8.3).				

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a Highly Unlikely unplanned hydrocarbon release as a result of a loss of topsides containment.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of topsides integrity and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha FPSO Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and Management System Performance Standards (MSPS) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures, and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with topsides loss of containment at Okha is managed to ALARP.

Demonstration of Acceptability

Topsides loss of containment has been evaluated as having a 'Moderate' risk rating. As per Section 2.8.2, Woodside considers 'Moderate' risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-03, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in Section 6.8.3 (MEE-01) (the considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 14 Topsides loss of containment risks to the environment limited to Moderate through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 14.1** Maintain topsides hydrocarbon-containing infrastructure integrity.	**PS 14.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: P01 – Pressure Vessel P02 – Heat Exchanger P03 – Rotating Equipment	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		P04 – Tanks P08 – Piping Systems; to together: • provide minimum required mechanical integrity for identified SCE systems (piping, heat exchangers, rotating equipment, and pressure vessel) for operation within defined integrity limits so as to prevent a loss of containment that may result in a MEE.	
	C 14.2 Maintain Safety Instrumented Systems and Relief System to prevent hydrocarbon loss of containment in order to prevent a MEE.	**PS 14.2** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System to: – detect and respond to pre-defined initiating conditions to protect mechanical integrity and prevent loss of containment (including uncontrolled diesel transfer/overflow) • F21 – Relief Systems to: – protect pressurised equipment, equipment exposed to high pressures and piping from a loss of containment to prevent escalation to a MEE.	Refer to **MC 12.1**
	Refer to **C 12.2**	Refer to **PS 12.2**	Refer to **MC 12.1**
	Refer to **C 13.2**	Refer to **PS 13.2**	Refer to **MC 12.1**
	C 14.3 Maintain Safety Instrumented Systems (e.g. emergency shutdown and safety instrumented functions) system, Blowdown and Open Hazardous Drains system to isolate, remove and control hazardous inventories so as to mitigate the effects of a MEE/ prevent escalation to a MEE.	**PS 14.3** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System to: – detect and respond to pre-defined initiating conditions and initiate responses that function to put the process plant,	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		equipment, and the wells in a safe condition through appropriate isolation of hazardous inventories so as to prevent or mitigate the effects of a MEE. • F09 – Depressurisation (Blowdown) to: – safely depressurise the installation in order to avoid, or minimise the escalation of an uncontrolled loss of containment. • F22 – Open Hazardous Drains to: – prevent escalation of an incident following loss of containment, fire and/or explosion by removing or containing flammable liquid from hazardous areas; and – support appropriate containment and disposal of environmentally hazardous liquids to avoid damage to the environment.	
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.6 Unplanned Hydrocarbon Release: Offtake Equipment Loss of Containment (MEE-04)

Context		
Offtake System and Offtake Tanker Mooring – Section 3.6.6	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Hydrocarbon release from Okha FPSO offtake equipment to the marine environment and atmosphere.	-	X	X	-	X	X	X	B	C	1	M	LCS GP PJ RBA CV SV	Acceptable if ALARP	EPO 15

Description of Source of Risk

Background

Stabilised crude product is transferred to a tandem moored offtake tanker via the stern mounted offtake hose. The Okha FPSO uses a standard ship's cargo pump arrangement (two pumps at 2000 m^3/h each) to manage and offload crude cargo. The Okha FPSO has an operational storage capacity of 934,000 bbl of oil.

In the event of an emergency on either the Okha FPSO or the offtake tanker during an offtake, the tanker would be released via a quick release of the hawser at the stern of the FPSO. This hook is either remotely activated or manually released via a nearby lever. The offtake system is equipped with a dry breakaway coupling which will release at a predetermined tension preventing significant damage to the offtake hose whilst minimising oil spillage.

The following causes could lead to loss of containment from the FPSO offtake system:

- internal corrosion
- external corrosion
- overpressure
- equipment fatigue/failure
- loss of control of offtake vessel
- mooring failure (during offtake operations).

Escalation from other MEEs could cause loss of containment from the FPSO offtake system:

- loss of structural integrity (MEE-06) (Section 6.8.8)
- loss of marine vessel separation (MEE-07) (Section 6.8.9)
- loss of control of suspended load from facility lifting operations (MEE-08) (Section 6.8.10).

Offtake Equipment Loss of Containment – Credible Hydrocarbon Spill Scenarios

The worst-case credible scenario for an offtake loss of containment modelled is considered to be ~724 m^3 of crude oil, which includes the loss of the entire inventory of the offtake hose and the release associated with continued pumping at the maximum rate of 4000 m^3 oil per hour for 10-minutes. This scenario assumes the 24-hour watch would not immediately identify the incident, and instead assumes a worst-case credible time of 10-minutes for detection and then activation/actuation of shutdown systems. The characteristics of the offtake equipment loss of containment scenario are summarised in Table 6-25.

Table 6-26: Summary of the worst-case offtake equipment loss of containment release scenario

Scenario	Hydrocarbon	Duration (minutes)	Depth (m)	Latitude (WGS84)	Longitude (WGS84)	Total Crude Release Volume (m^3)
Offtake equipment loss of containment	Cossack (Okha) light crude	10	Surface	19° 35' 21" S	116° 26' 48" E	724 m^3

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in FPSO operation. In the company's 60-year history, it has not experienced any offtake events that have resulted significant environmental impacts. The Okha facility has never experienced a worst-case offtake loss of containment in its operational history.

Decision Type

Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling (Section 6.8.1). Company values were also considered in the demonstration of ALARP and acceptability.

The release of hydrocarbons from an offtake equipment loss of containment is considered a MEE (MEE-04). The hazard associated with this MEE is hydrocarbons contained within the offtake equipment. Note that Woodside has assessed the environment consequence of a worst-case credible loss of containment from offtake equipment as 'C' as per the Woodside Risk Matrix. Woodside has also assessed the reputational and brand consequences associated with this release and concluded that the event results in a 'B' level consequence, and hence meets Woodside's definition of a MEE (refer to Section 2.7.2).

Quantitative Spill Risk Assessment

Stochastic spill modelling of worst-case credible offtake equipment loss of containment scenario was undertaken by RPS APASA, on behalf of Woodside. The simulation was a 10-minute release based on the assumptions in Section 6.8.1. Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volume for an offtake equipment loss of containment.

Hydrocarbon Characteristics

Refer to Section 6.8.1.1 for Cossack light crude characteristics.

Consequence

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case offtake equipment loss of containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.3) and relevant literature and studies considering the effects of hydrocarbon exposure.

Likelihood

In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance), the likelihood of a worst-case topsides loss of containment has been taken as Highly Unlikely (1).

Consequence Assessment

Environment that May Be Affected

Surface Hydrocarbons

The modelled surface hydrocarbons are forecast to drift down current of the release location with the trajectory dependent on prevailing wind and current conditions at the time, and may extend up to 65 km from the release site. Modelling results indicate no contact with sensitive receptors by surface (floating) hydrocarbons above the impact threshold (10 g/m^2) at probabilities of 1% or greater. At the Socio-cultural EMBA threshold only Glomar Shoal is predicted to be contacted (3% probability).

Entrained Hydrocarbons

Modelling results indicate no contact with sensitive receptors by entrained hydrocarbons above impact the threshold (400 ppb) at probabilities of 1% or greater.

Dissolved Hydrocarbons

Consequence Assessment
Modelling results indicate no contact with sensitive receptors by dissolved hydrocarbons above the impact threshold (400 ppb) at probabilities of 1% or greater. Accumulated Hydrocarbons Modelling results indicate no contact with sensitive receptors by accumulated shoreline hydrocarbons above the impact threshold (100 g/m^2) at probabilities or 1% of greater, with a maximum accumulated volume of <1 m^3 along all shoreline receptors. ***Consequence Assessment Summary*** Modelling of the credible worst-case hydrocarbon spill scenario that may arise from MEE-04 indicates that the spill will remain offshore with contact limited to the Ancient Coastline at 125 m Depth Contour KEF and the Glomar Shoal KEF. The biological consequences of such a spill on identified open water sensitive receptors relate to the potential for moderate, medium-term impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill affected area. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01 (Section 6.8.3).

MEE-04 Offtake Equipment Loss of Containment – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-04; refer to Figure 6-18, Figure 6-19, Figure 6-20, and Figure 6-21 for bowtie diagrams.

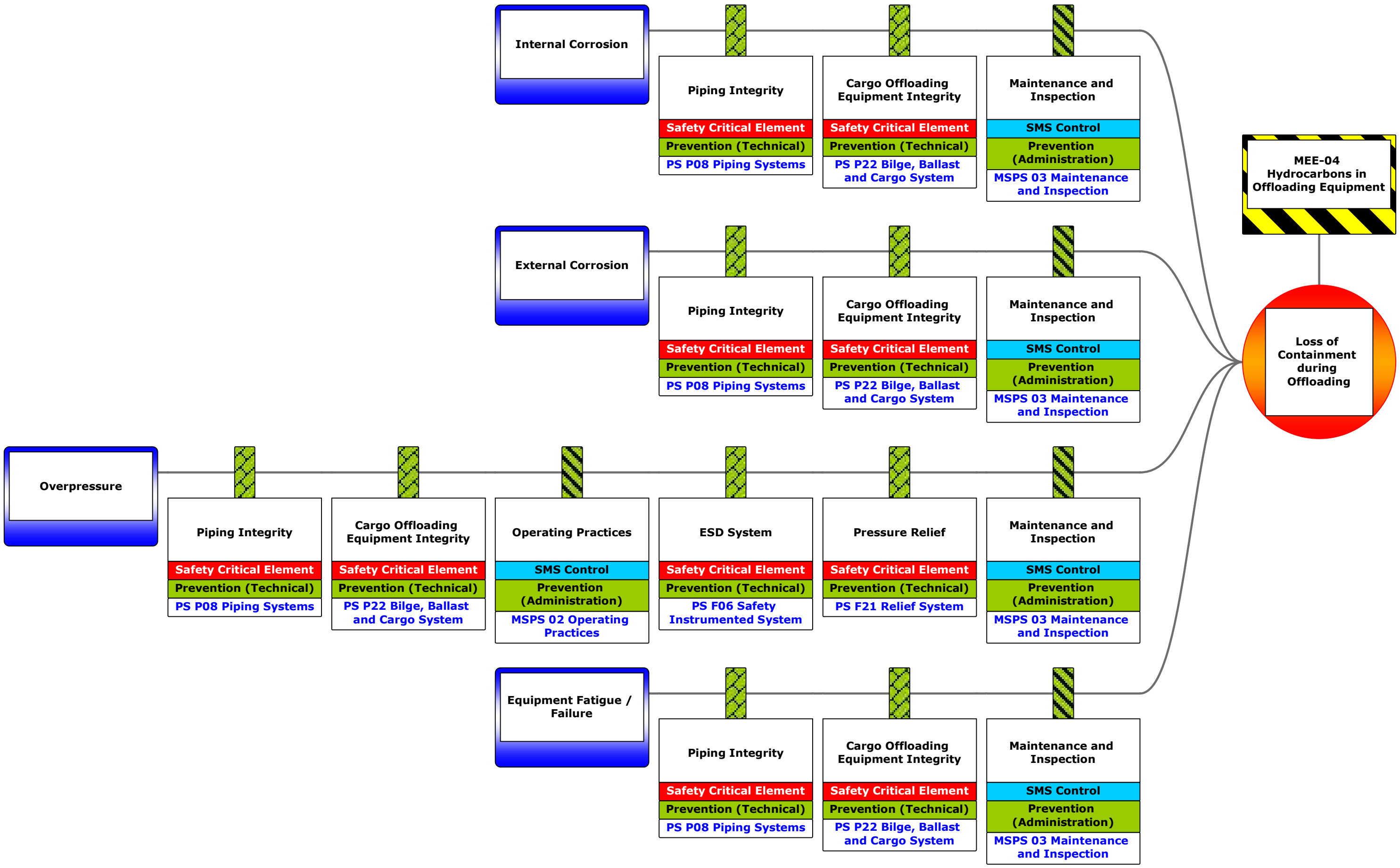

Figure 6-18: MEE-04 Offtake Loss of Containment (Causes 1–4)

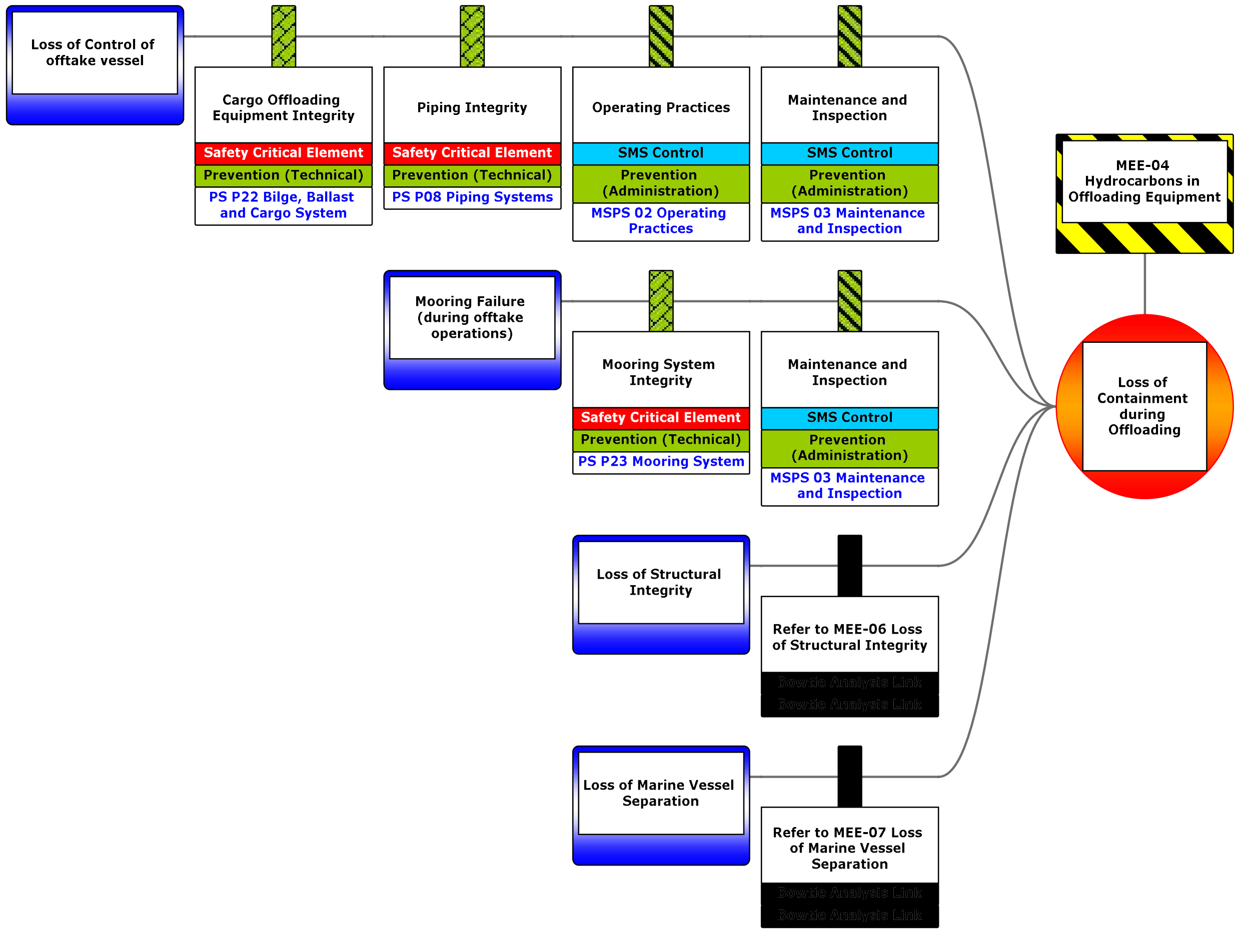

Figure 6-19: MEE-04 Offtake Loss of Containment (Causes 5–8)

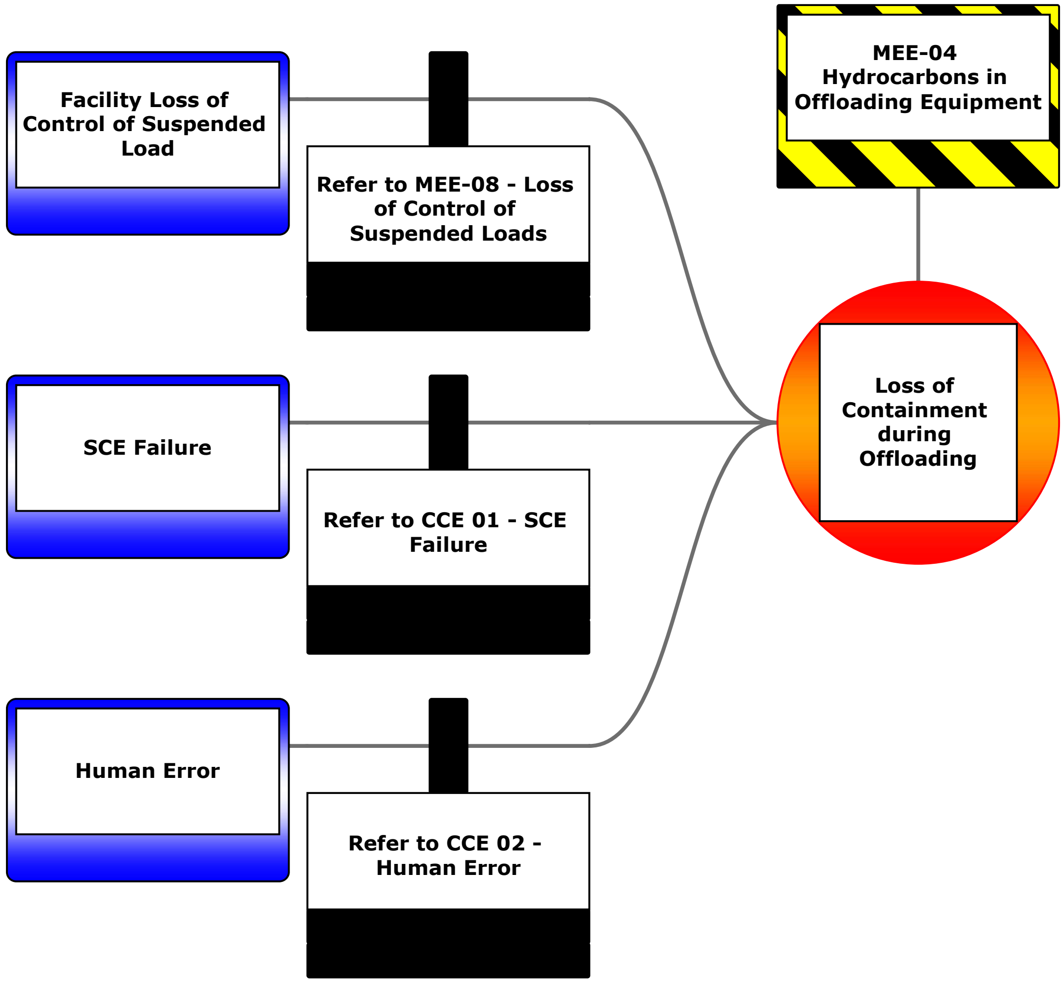

Figure 6-20: MEE-04 Offtake Loss of Containment (Causes 9–11)

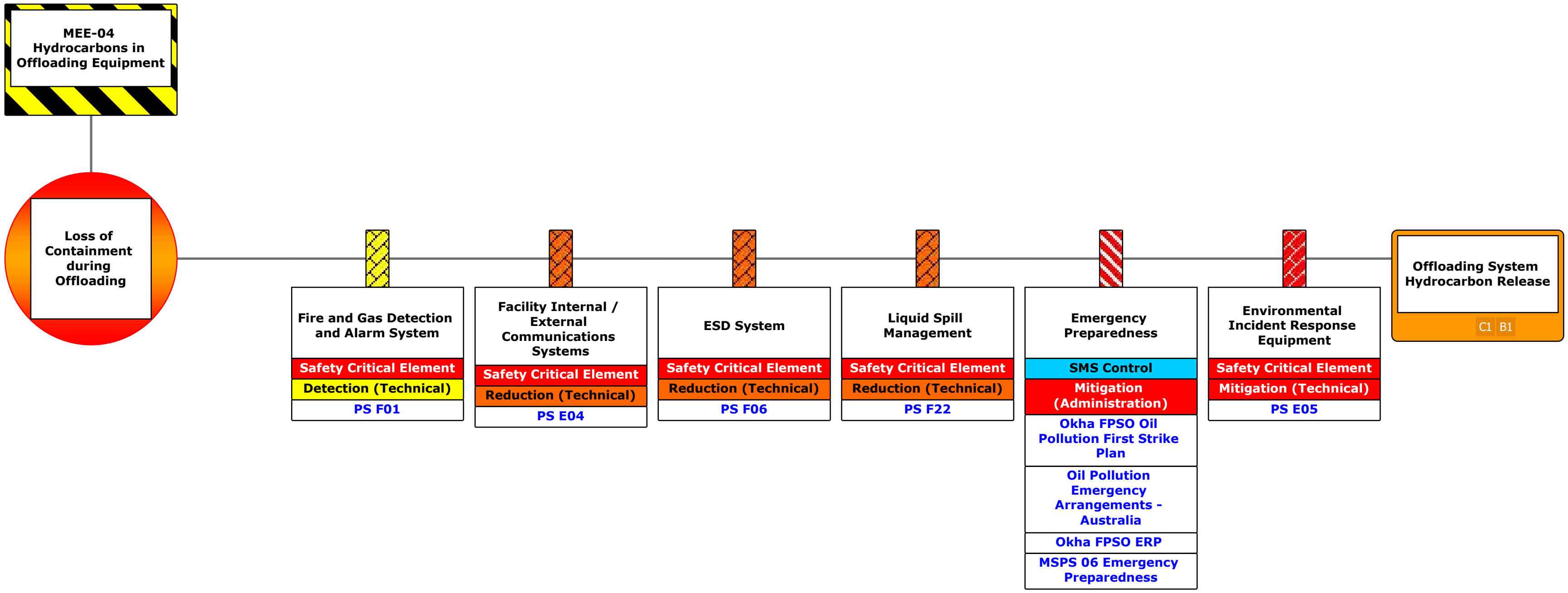

Figure 6-21: MEE-04 Offtake Loss of Containment (Outcomes)

MEE-04 Offtake Equipment Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain offtake equipment hydrocarbon-containing infrastructure integrity.	P08 – Piping Systems P22 – Bilge, Ballast and Cargo Systems P23 – Mooring Systems F06 – Safety Instrumented System F21 – Relief Systems	Prevention (Technical)	Yes **C 15.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies.	E04 – Safety Critical Communications	Mitigation (Technical)	Yes **C 12.2**
Engineering Controls	Maintain Fire and Gas detection and Alarm Systems on Okha facility to facilitate prevention and response to fire or gas hazards.	F01 – Fire and Gas Detection and Alarm System	Detection (Technical)	Yes **C 13.2**
Engineering Controls	Maintain Safety Instrumented System (Safety Instrumented Functions and emergency shutdown actions) to detect and respond to predefined initiating conditions and/or initiate responses that put the process plant and equipment in a safe condition (e.g. through appropriate isolation of hazardous inventories) so as to prevent or mitigate the effects of a MEE.	F06 – Safety Instrumented System	Reduction / Control (Technical)	Yes **C 15.2**
Engineering Controls	Maintain stability and reduce hull stresses during offtake to prevent or mitigate a MEE.	P22 – Bilge, Ballast and Cargo Systems	Mitigation (Technical)	Yes **C 15.3**
Emergency Response	Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C12.4**

MEE-04 Offtake Equipment Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha FPSO to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks – describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP. Thus, contributing to management of associated potential environmental consequences of MAEs.	Okha Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements. Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Yes **C 8.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain:	MSPS-02 Operating Practices	Prevention (Administration)	Yes – See Section 7

MEE-04 Offtake Equipment Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	• M02 Operating Practices • M03 Maintenance and Inspections.	MSPS-03 Maintenance and Inspections		Implementation Strategy.
Procedures and Administration	Implement offtake procedures: • Offtake Tanker FPSO Compatibility Procedure; and • Tanker Assurance Procedure.	Offtake Tanker FPSO Compatibility Procedure Tanker Assurance Procedure	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Emergency Response and contingency planning	Implement management systems to maintain: • M06 – Emergency Preparedness • Okha Emergency Response Plan • Okha Oil Pollution First Strike Plan (Appendix H) • Oil Pollution Emergency Arrangements – Australia.	MSPS 06 – Emergency Preparedness Okha Emergency Response Plan Okha Oil Pollution First Strike Plan (Appendix H) Oil Pollution Emergency Arrangements – Australia	Mitigation (Administration)	Yes – See Section 7 Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.

Risk Based Analysis

For risks identified as MEEs, a more detailed risk-based Bowtie Analysis (as outlined in Section 2.7.3) has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

Application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-04; refer to Figure 6-18, Figure 6-19, Figure 6-20, and Figure 6-21 for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer Section 6.8.1).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

Societal Values

Refer to Societal Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

MEE-04 Offtake Equipment Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a Highly Unlikely unplanned hydrocarbon release as a result of an offtake equipment loss of containment.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of the offtake system and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and Management System Performance Standards (MSPS) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with offtake equipment loss of containment at Okha is managed to ALARP.

Demonstration of Acceptability

Offtake equipment loss of containment has been evaluated as having a ‘Moderate’ risk rating. As per Section 2.8.2, Woodside considers ‘Moderate’ risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-04, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in Section 6.8.3 (MEE-01) (the considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 15 Offloading loss of containment risks to the environment limited to Moderate through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 15.1** Maintain offloading equipment hydrocarbon-containing infrastructure integrity.	**PS 15.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P08 – Piping Systems; to: – provide minimum required mechanical integrity for identified Safety and Environment Critical Piping so as to prevent a loss of containment that may result in a MEE (for operation within defined integrity limits). • P22 – Bilge, Ballast and Cargo Systems; to: – maintain hull stress and vessel stability within integrity limits. • P23 – Mooring Systems; to: – provide station keeping within allowable excursion envelope; – provide ability to disconnect facility from mooring on demand – provide ability to disconnect offtake tanker from facility on demand. • F06 – Safety Instrumented System; to: – detect and respond to pre-defined initiating conditions to protect mechanical integrity. • • F21 – Relief Systems; to: – protect pressurised equipment, equipment exposed to high pressures and piping from a loss of containment to prevent escalation to a MEE.	Refer to **MC 12.1**
	Refer to **C 12.2**	Refer to **PS 12.2**	Refer to **MC 12.1**
	Refer to **C 13.2**	Refer to **PS 13.2**	Refer to **MC 12.1**
	C 15.2 Maintain Safety Instrumented System (Safety Instrumented	**PS 15.2** Integrity will be managed in accordance with SCE Management Procedure	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	Functions and ESD actions) to detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant and equipment in a safe condition (e.g. through appropriate isolation of hazardous inventories) so as to prevent or mitigate the effects of a MEE.	(Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System to: – detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant and equipment in a safe condition so as to prevent or mitigate the effects of a MEE.	
	C 15.3 Maintain stability and reduce hull stresses during offloading to prevent or mitigate a MEE.	**PS 15.3** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P22 – Bilge, Ballast and Cargo Systems to: – maintain hull stress and vessel stability within integrity limits.	Refer to **MC 12.1**
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.7 Unplanned Hydrocarbon Release: Cargo Tank Loss of Containment (MEE-05)

Context		
Cargo Tanks – Section 3.6.5	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Hydrocarbon release caused by cargo tank loss of containment.	-	X	X	-	X	X	X	B	A	1	H	LCS GP PJ RBA CV SV	Acceptable if ALARP	EPO 16

Description of Source of Risk

Background

The Okha FPSO has a total of 11 dedicated cargo tanks which are designed to receive and store crude oil directly from topsides process plant. The crude oil is fed from the topsides directly to the cargo tanks by dedicated drop lines into the top of all cargo tanks. The individual storage tanks range in capacity, with a total operational storage capacity of 934,000 bbl of oil. A loss of containment from a cargo tank may result in a significant volume of crude being released to the marine environment. Due to the potential consequences, a cargo tank loss of containment is considered a MEE (MEE-05). The potential hazard sources that could instigate a cargo tank loss of containment are:

- corrosion
- overpressure or under pressure
- tank leakage/over filling
- equipment fatigue
- loss of containment between cargo tanks
- loss of cargo tank atmosphere control
- cargo tank vacuum.

Escalation from other MEEs could cause loss of containment from the FPSO cargo tanks:

- loss of structural integrity (MEE-06) (Section 6.8.8)
- loss of marine vessel separation (MEE-07) (Section 6.8.9)
- loss of control of suspended load from facility lifting operations (MEE-08) (Section 6.8.10).

FPSO Cargo Tank Loss of Containment – Credible Hydrocarbon Spill Scenarios

There is a credible worst-case loss of containment scenario caused by bulkhead damage resulting in the loss of two adjacent cargo tanks. As such, the worst-case credible loss of containment scenario from a cargo tank spill on the Okha FPSO is taken as 30,302 m^3 of crude. This volume is based on the assumption that the largest cargo tank and the next largest adjacent cargo tank both lost their entire inventory (standard loading limit – tank capacity at 98%). This scenario is considered conservative given that for the entire inventory to be lost from a tank, it would require the point of rupture to be such that the entire volume could drain freely from the tank to the environment (e.g. point of rupture would have to be at the bottom part of a tank). Whereas rupture from a vessel collision would be at the water line and thus at the upper side of the tank).

A loss of containment of diesel fuel stored within the vessel hull due to vessel collision is also a credible event. The single largest inventory of diesel within the hull is the Port diesel Bunker Tank No.3 (1230 m^3). The cargo tank loss of containment event has been selected to inform the risk assessment due to the larger potential release volume. Release characteristics for cargo tank loss of containment scenario are summarised in Table 6-26.

Table 6-27: Summary of the worst-case cargo tank loss of containment release scenario

Scenario	Hydrocarbon	Duration (hours)	Depth (m)	Latitude (WGS84)	Longitude (WGS84)	Total Crude Release Volume (m^3)
Cargo tank loss of containment	Cossack (Okha) light crude	24 hours	Surface	19° 35' 21" S	116° 26' 48" E	30,302 m^3

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in FPSO operation. In the company's 60-year history, it has not experienced any cargo tank integrity events that have resulted significant environmental impacts. The Okha facility has never experienced a worst-case cargo tank loss of containment in its operational history.

Decision Type

Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling (Section 6.8.1). Company values were also considered in the demonstration of ALARP and acceptability.

The release of hydrocarbons from an Okha FPSO cargo tank loss of containment is considered a MEE (MEE-05). The hazard associated with this MEE is hydrocarbons contained within the Okha FPSO cargo tanks.

Quantitative Spill Risk Assessment

Stochastic spill modelling of worst-case credible offtake equipment loss of containment scenario was undertaken by RPS APASA, on behalf of Woodside. The simulation was a phased release over 24 hours based on the assumptions in Section 6.8.1. Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volume for an Okha FPSO cargo tank loss of containment.

Hydrocarbon Characteristics

Refer to Section 6.8.1.1 for Cossack light crude characteristics.

Consequence

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case Okha FPSO cargo tank loss of containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.3) and relevant literature and studies considering the effects of hydrocarbon exposure.

Likelihood

In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance), the likelihood of a worst-case topsides loss of containment has been taken as Highly Unlikely (1).

Consequence Assessment

Environment that May Be Affected

Surface Hydrocarbons

Quantitative hydrocarbon spill modelling results for surface hydrocarbons are shown in Table 6-27. The modelled surface hydrocarbons are forecast to drift down current of the release location with the trajectory dependent on prevailing wind and current conditions at the time, and may extend up to 292 km from the release site at concentrations above the impact threshold (10 g/m²). Modelling results indicate a potential for contact by surface (floating) hydrocarbons above the impact threshold for the Montebello Islands (1% probability for AMP and State Marine Park). However, no other receptors were predicted to be contacted at probabilities of 1% or greater. At the 1 g/m² socio-cultural threshold a number of receptors are contacted with the highest probability found at Montebello AMP (10%).

Entrained Hydrocarbons

Quantitative hydrocarbon spill modelling results for entrained hydrocarbons are shown in Table 6-27. Contact by entrained oil at concentrations equal to or above the impact threshold (400 ppb) is predicted at the Montebello Islands

Consequence Assessment
(18%), as well as at several other sensitive receptors with probabilities less than 10%. The maximum entrained oil concentration forecast for any receptor is predicted as 9.2 ppm at the Montebello State Marine Park. Dissolved Hydrocarbons Quantitative hydrocarbon spill modelling results for dissolved hydrocarbons are shown in Table 6-27. Dissolved hydrocarbons at concentrations equal to or above the 400 ppb threshold are predicted to extent up to 575 km from the release site. Contact by dissolved hydrocarbons at concentrations equal to or above the 400 ppb threshold is predicted to be greatest at Montebello AMP (15%), as well as at several other sensitive receptors with probabilities less than 10%. The maximum dissolved hydrocarbon concentration forecast for any receptor is predicted as 14.4 ppm at the Montebello AMP. Accumulated Hydrocarbons Quantitative hydrocarbon spill modelling results for accumulated hydrocarbons are shown in Table 6-27. The Montebello Islands, Muiron Islands Marine Management Area – World Heritage Area, Pilbara Islands – Southern Island Group, and Muiron Islands shoreline receptors are predicted to experience shoreline accumulation in excess of the 100 g/m^2 threshold with a probability of 4%. Potential for accumulation of hydrocarbons on shorelines is predicted to be greatest at the Montebello Islands. ***Consequence Assessment Summary*** Modelling of the credible worst-case hydrocarbon spill scenario that may arise from MEE-05 indicates that the spill may impact upon a number of environmental receptors (Table 6-27). The biological consequences of such a spill on identified open water sensitive receptors relate to the potential for catastrophic, long-term impacts to environmental receptors within the spill affected area. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01 (Section 6.8.3). The credible worst-case hydrocarbon volumes that can credibly be released by MEE-05 are considerably smaller than the credible worst-case loss of well containment volumes considered in MEE-01 (Section 6.8.3). Additionally, the credible release durations are significantly shorter. These considerations are reflected in the significantly smaller EMBA presented in Table 6-27.

Table 6-28: Key receptor locations and sensitivities potentially contacted above impact thresholds by the cargo tank loss of containment scenario with summary hydrocarbon spill contact (table cell values correspond to probability of contact [%])

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 and fate (%) (Cossack (Okha) light crude)				
		Physical		Biological																						Socioeconomic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species											
		Open water – (pristine)	Marine Sediment – (pristine)	Coral reef	Seagrass beds / Macroalgae	Mangroves	Spawning/nursery areas	Open water – Productivity/upwelling	Non biogenic 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 (foraging areas, internesting areas and significant nesting beaches)	Sea snakes	Whale sharks	Sharks and rays	Seabirds and/or migratory shorebirds	Pelagic fish populations	Resident /Demersal Fish	Fisheries – commercial	Fisheries – traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≤10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥100 ppb)	Accumulated hydrocarbons (>100 g/m²)
Offshore[25]	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		10	1	18	15	N/A
	Ningaloo AMP	✓	✓					✓		✓					✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓		2	-	2	-	N/A
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	-	-	4	2	N/A
	Argo-Rowley Terrace AMP	✓	✓					✓							✓	✓			✓			✓	✓	✓		✓			✓		-	-	-	-	N/A
Submerged Shoals and Banks	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			5	-	-	4	N/A
	Glomar Shoal	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			6	-	-	6	N/A
Islands	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		4	1	8	4	4
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓		✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	2	-	4	2	3
	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		4	-	4	2	4

25 Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent.

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 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 (foraging areas, internesting areas and significant nesting beaches)	Biological: Protected Species – Sea snakes	Biological: Protected Species – Whale sharks	Biological: Protected Species – Sharks and rays	Biological: Protected Species – Seabirds and/or migratory shorebirds	Biological: Other Species – Pelagic fish populations	Biological: Other Species – Resident /Demersal Fish	Socioeconomic and Cultural: Fisheries – commercial	Socioeconomic and Cultural: Fisheries – traditional	Socioeconomic and Cultural: Tourism and Recreation	Socioeconomic and Cultural: Protected Areas / Heritage – European and Indigenous / Underwater Cultural Heritage	Socioeconomic and Cultural: Offshore Oil and Gas Infrastructure (topside and subsea)	Probability of hydrocarbon contact and fate (%) (Cossack (Okha) light crude): Surface hydrocarbon (≤10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥100 ppb)	Accumulated hydrocarbons (>100 g/m²)
	Bessieres Islands – State Nature Reserves)																																		
	Pilbara Islands – Middle Island Group	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	-	-	2
	Muiron Islands (WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		2	-	2	-	4
Mainland (nearshore waters)	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		1	-	1	-	4

MEE-05 Cargo Tank Loss of Containment – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-05; refer to Figure 6-22, Figure 6-23, Figure 6-24, and Figure 6-25 for bowtie diagrams.

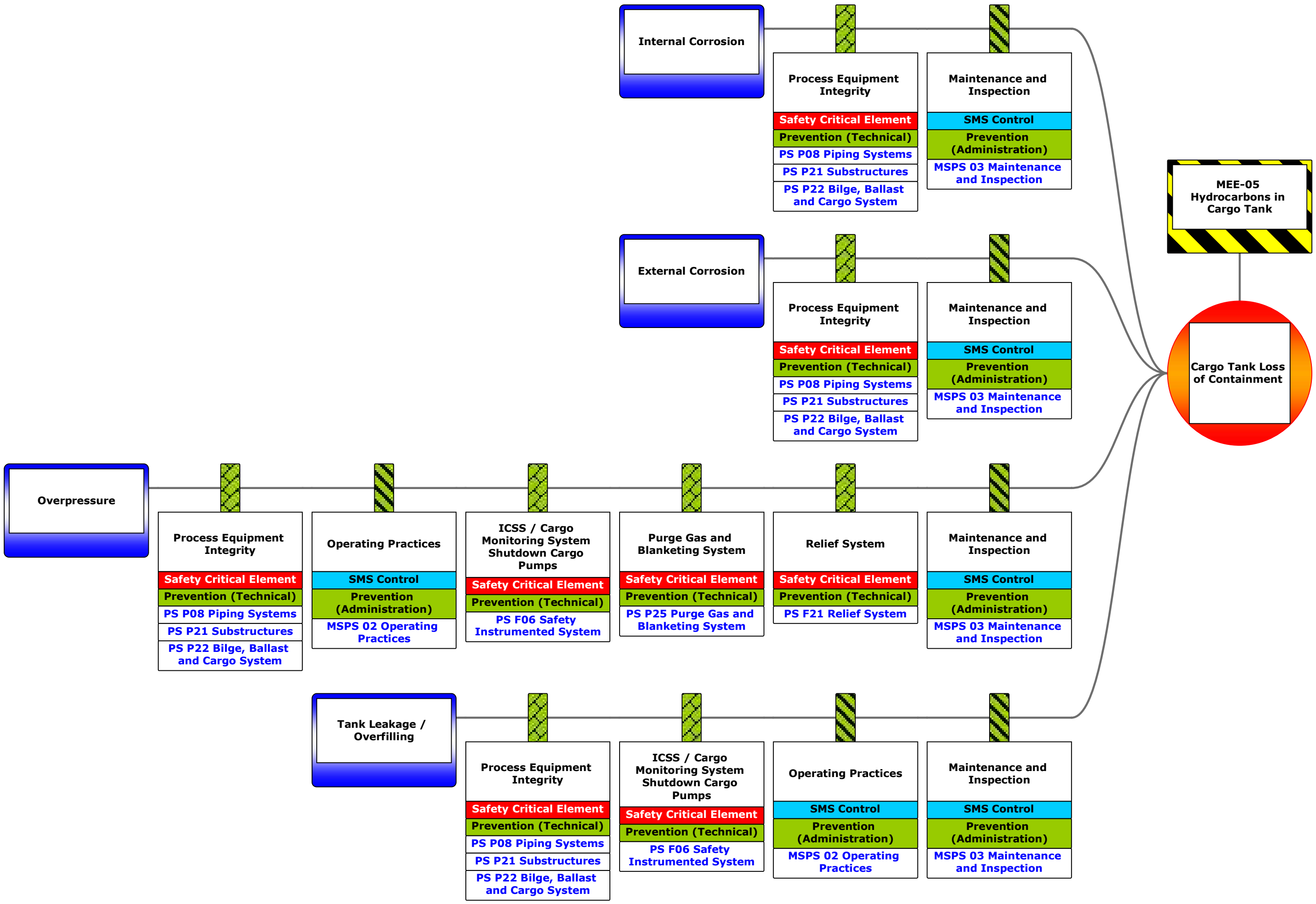

Figure 6-22: MEE-05 Cargo Tank Loss of Containment (Causes 1–4)

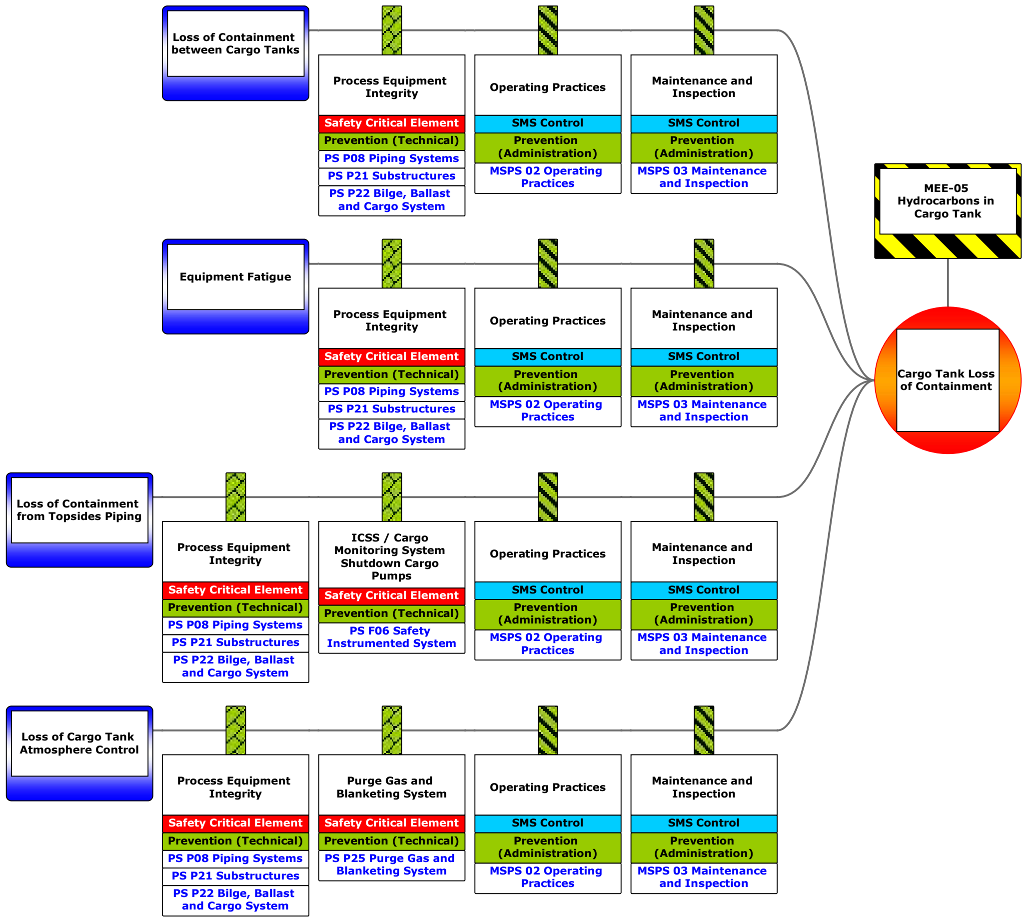

Figure 6-23: MEE-05 Cargo Tank Loss of Containment (Causes 5–8)

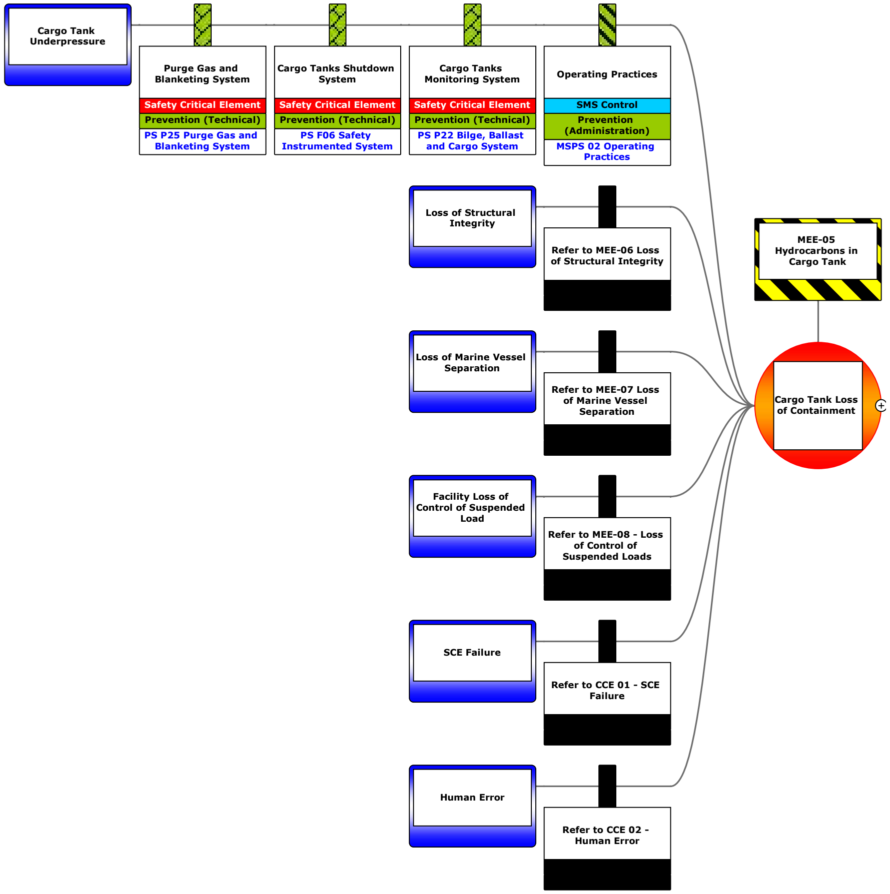

Figure 6-24: MEE-05 Cargo Tank Loss of Containment (Causes 9–14)

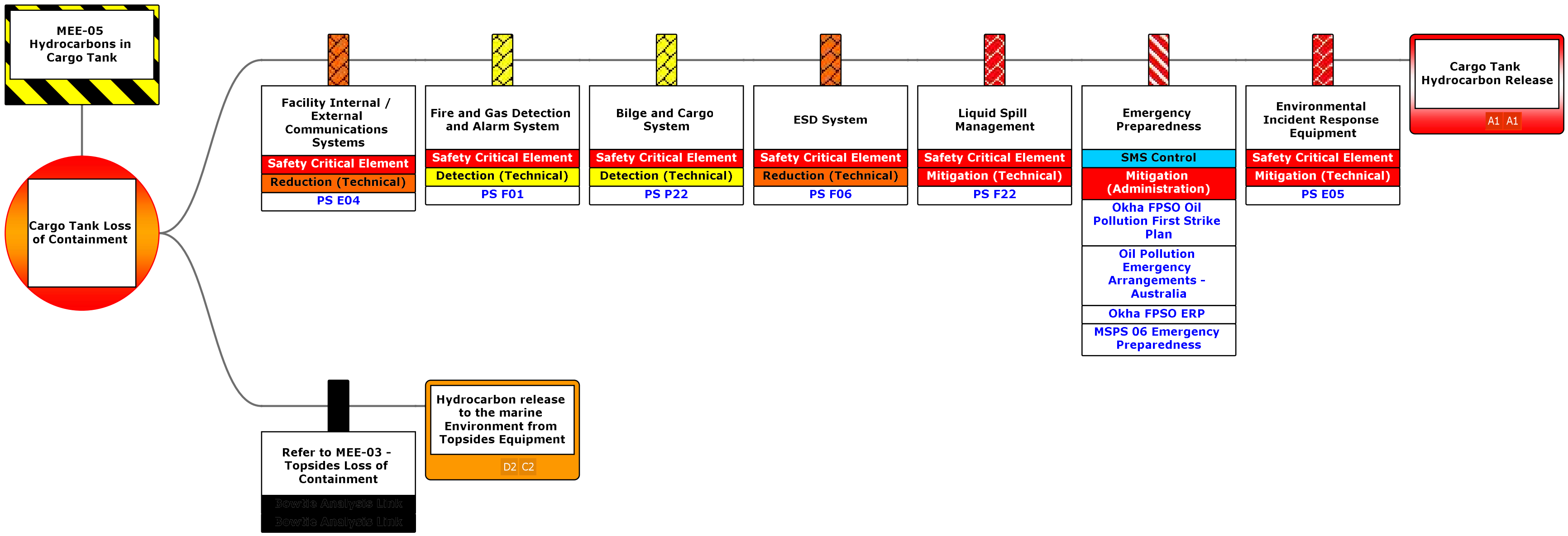

Figure 6-25: MEE-05 Cargo Tank Loss of Containment (Outcomes)

MEE-05 Cargo Tank Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain cargo system hydrocarbon-containing infrastructure integrity	P08 – Piping Systems P21 – Substructures P22 – Bilge, Ballast and Cargo Systems P25 – Purge Gas and Blanketing System F06 – Safety Instrumented System F21 – Relief Systems	Prevention (Technical)	Yes **C 16.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies.	E04 – Safety Critical Communications	Mitigation (Technical)	Yes **C 12.2**
Engineering Controls	Maintain Fire and Gas detection and Alarm Systems to facilitate prevention and response to fire or gas hazards.	F01 – Fire and Gas Detection and Alarm System	Detection (Technical)	Yes **C 13.2**
Engineering Controls	Maintain bilge detection and alarm systems to mitigate a MEE.	P22 – Bilge, Ballast and Cargo Systems	Detection (Control)	Yes **C 15.3**
Engineering Controls	Maintain Safety Instrumented System (Safety Instrumented Functions and emergency shutdown actions) to detect and respond to predefined initiating conditions and/or initiate responses that put the process plant and equipment in a safe condition (e.g. through appropriate isolation of hazardous inventories) so as to prevent or mitigate the effects of a MEE.	F06 – Safety Instrumented System	Reduction / Control (Technical)	Yes **C 15.2**
Engineering Controls	Maintain open hazardous drains to remove and control environmentally hazardous liquid discharges to prevent or mitigate a MEE.	F22 – Open Hazardous Drains	Mitigation (Technical)	Yes **C 15.3**

MEE-05 Cargo Tank Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Emergency Response	Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 12.4**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha FPSO to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks – describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP. Thus, contributing to management of associated potential environmental consequences of MAEs.	Okha Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements. Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory	Yes **C 8.5**

MEE-05 Cargo Tank Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
			reporting requirements.	
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections.	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Emergency Response and contingency planning	Implement management systems to maintain: • M06 – Emergency Preparedness • Okha Emergency Response Plan • Okha Oil Pollution First Strike Plan (Appendix H) • Oil Pollution Emergency Arrangements – Australia.	MSPS 06 – Emergency Preparedness Okha Emergency Response Plan Okha Oil Pollution First Strike Plan (Appendix H) Oil Pollution Emergency Arrangements – Australia	Mitigation (Administration)	Yes – See Section 7 Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.

Risk Based Analysis

For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7.3) has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

Application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-05; refer to Figure 6-22, Figure 6-23, Figure 6-24 and Figure 6-25 for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer to Section 6.8.1).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

Societal Values

Refer to Societal Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a Highly Unlikely unplanned hydrocarbon release as a result of an Okha FPSO cargo tank loss of containment.

MEE-05 Cargo Tank Loss of Containment – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of the Okha FPSO and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and Management System Performance Standards (MSPS) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Okha FPSO cargo tank loss of containment is managed to ALARP.

Demonstration of Acceptability

A cargo tank loss of containment has been evaluated as having a 'High' risk rating. As per Section 2.8.2, Woodside considers 'High' risk ratings as acceptable if managed to ALARP. Due to the consequence associated with MEE-05, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in Section 6.8.3 (MEE-01) (the considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 16 Cargo tank loss of containment risks to the environment limited to High through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 16.1** Maintain cargo system hydrocarbon-containing infrastructure integrity.	Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P08 – Piping Systems to: – provide minimum required mechanical integrity for identified Safety and Environment Critical Piping so as to prevent a loss of containment that may result in a MEE (for operation within defined integrity limits). • P21 – Substructures to: – provide and maintain structural integrity to support SCE systems under all design	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		conditions through service life – prevent structural failure from contributing to the escalation of a MEE by providing support/protection of SCE systems during an emergency event, and/or support containment of environmentally hazardous materials • P22 – Bilge, Ballast and Cargo Systems to: – maintain hull stress and vessel stability within integrity limits. • P25 – Purge Gas and Blanketing System to: – safely prevent the creation of an explosive atmosphere by either preventing oxygen ingress or dilution of hydrocarbon stream. • F06 – Safety Instrumented System to: – detect and respond to pre-defined initiating conditions to protect mechanical integrity. • F21 – Relief Systems to: – protect pressurised equipment, equipment exposed to high pressures and piping from a loss of containment to prevent escalation to a MEE.	
	Refer to **C 12.2**	Refer to **PS 12.2**	Refer to **MC 12.1**
	Refer to **C 13.2**	Refer to **PS 13.2**	Refer to **MC 12.1**
	C 16.2 Maintain bilge detection and alarm systems to mitigate a MEE.	**PS 16.2** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P22 – Bilge, Ballast and Cargo Systems: – to maintain hull stress and vessel stability within integrity limits.	Refer to **MC 12.1**
	Refer to **C 15.2**	Refer to **C 15.2**	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 16.3 Maintain open hazardous drains to remove and control environmentally hazardous liquid discharges to prevent or mitigate a MEE.	**PS 16.3** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F22 – Open Hazardous Drains to: – prevent escalation of an incident following loss of containment, fire and/or explosion by removing or containing flammable liquid from hazardous areas – support appropriate containment and disposal of environmentally hazardous liquids to avoid damage to the environment.	Refer to **MC 12.1**
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.8 Unplanned Hydrocarbon Release: Loss of Structural Integrity (MEE-06)

Context		
Wells and Reservoirs – Section 3.5.2 Subsea Infrastructure – Section 3.5.3 Topsides – Section 3.5.1 Process Description – Section 3.6.2	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Hydrocarbon release caused by a loss of structural integrity, leading to: • MEE-02 – subsea equipment loss of containment • MEE-03 – Topsides loss of containment • MEE-04 – Offtake equipment loss of containment • MEE-05 – FPSO Cargo tank loss of containment.	-	X	X	X	X	X	X	B	A	1	H	LCS GP PJ RBA CV SV	Acceptable if ALARP	EPO 17

Description of Source of Risk

Background

The Okha FPSO contains hydrocarbons in a range of infrastructure, including cargo tanks, process inventory, non-process inventory, flowlines and risers.

Woodside has identified the potential for hydrocarbon release due to the extreme environmental conditions or other causes which result in an exceedance of the design criteria and a catastrophic failure of the facility and individual equipment (e.g. cranes, flare, etc.) which could cause damage to adjacent equipment, leading to hydrocarbon releases to the environment.

Extreme environmental conditions (cyclone) could result in loss of structural integrity of the Okha FPSO resulting in significant oil spill to the environment (from risers, cargo tanks and/or topsides equipment). There is also the possibility of Okha FPSO capsizing or foundering caused by strong winds and extreme waves. This may induce pipework fatigue and loose/dislodged objects/projectiles causing impact to equipment/pipework resulting in loss of containment. Structural failures could be localised, or could, in more extreme situations, result in loss of containment from multiple storage locations on the Okha FPSO.

Extreme environmental conditions may also result in movement of the vessel and result in releases from lowlines/risers (MEE-02) or topsides equipment or storage (MEE-02–MEE-05). The worst-case environmental consequence ranking is an ‘A’ for these events related to Loss of Structural Integrity. The release of hydrocarbons as a result of loss of structural integrity is considered a Major Environment Event (MEE-06). The hazard associated with this MEE is hydrocarbons in the Okha facility.

Context
The following causes of structural failure of the Okha facility were identified: • internal and external corrosion • equipment fatigue • extreme weather (cyclone, high waves) • mooring system failure • vessel stresses through loading and stability • fire or explosion escalation to structure (including events captured in MEE-02, MEE-03, MEE-04 and MEE-05). A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in Section 6.8.11. ***Loss of Structural Integrity – Credible Hydrocarbon Spill Scenario*** A loss of structural integrity could result in a significant release of hydrocarbons. A loss of structural integrity may result in credible spill scenarios consistent with a loss of well containment (MEE-01, Section 6.8.3), subsea equipment loss of containment (MEE-02, Section 6.8.4), topsides loss of containment (MEE-03, Section 6.8.5) and Okha FPSO cargo tank loss of containment (MEE-05, Section 6.8.7). The worst-case credible spill scenarios associated with these MEEs are discussed in the relevant sections above; refer to these sections for further information. ***Decision Type, Risk Analysis and ALARP Tools*** Woodside has a good history of implementing industry standard practice in structural design and construction. The Okha facility has never experienced a worst-case loss of containment due to structural failure in its operational history. Decision Type Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk-based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling. Company and societal values were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation. The loss of structural integrity is considered a Major Environment Event (MEE-06). The hazard associated with this MEE is hydrocarbons contained within the Okha FPSO and associated infrastructure. Quantitative Spill Risk Assessment Credible worst-case stochastic spill modelling for the scenarios associated with MEE-01 (Section 6.8.3), MEE-02 (MEE-02, Section 6.8.4), MEE-03 (MEE-03, Section 6.8.5) and MEE-05 (Section 6.8.7) has been undertaken. Results of these modelling studies have been used to inform the consequence assessment for these MEEs; these assessments are applicable to the consequence assessment for a loss of structural integrity event. Consequence The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a loss of structural integrity. These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS APASA, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.3) and relevant literature and studies considering the effects of hydrocarbon exposure. Likelihood In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance), the likelihood has been taken as Highly Unlikely (1).

Consequence Assessment
As discussed above, the potential impacts from hydrocarbon release caused by a loss of structural integrity are those which would result from: • Loss of Well Containment, Section 6.8.3 (MEE-01) • Subsea Equipment Loss of Containment, Section 6.8.4 (MEE-02) • Topsides Loss of Containment, Section 6.8.5 (MEE-03) • Offtake Equipment Loss of Containment, Section 6.8.6 (MEE-04) • Cargo Tank Loss of Containment, Section 6.8.7 (MEE-05). The potential impacts are therefore discussed in the above mentioned sections.

MEE-06 Loss of Structural Integrity – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-06; refer to Figure 6-26, Figure 6-27, and Figure 6-28 for bowtie diagrams.

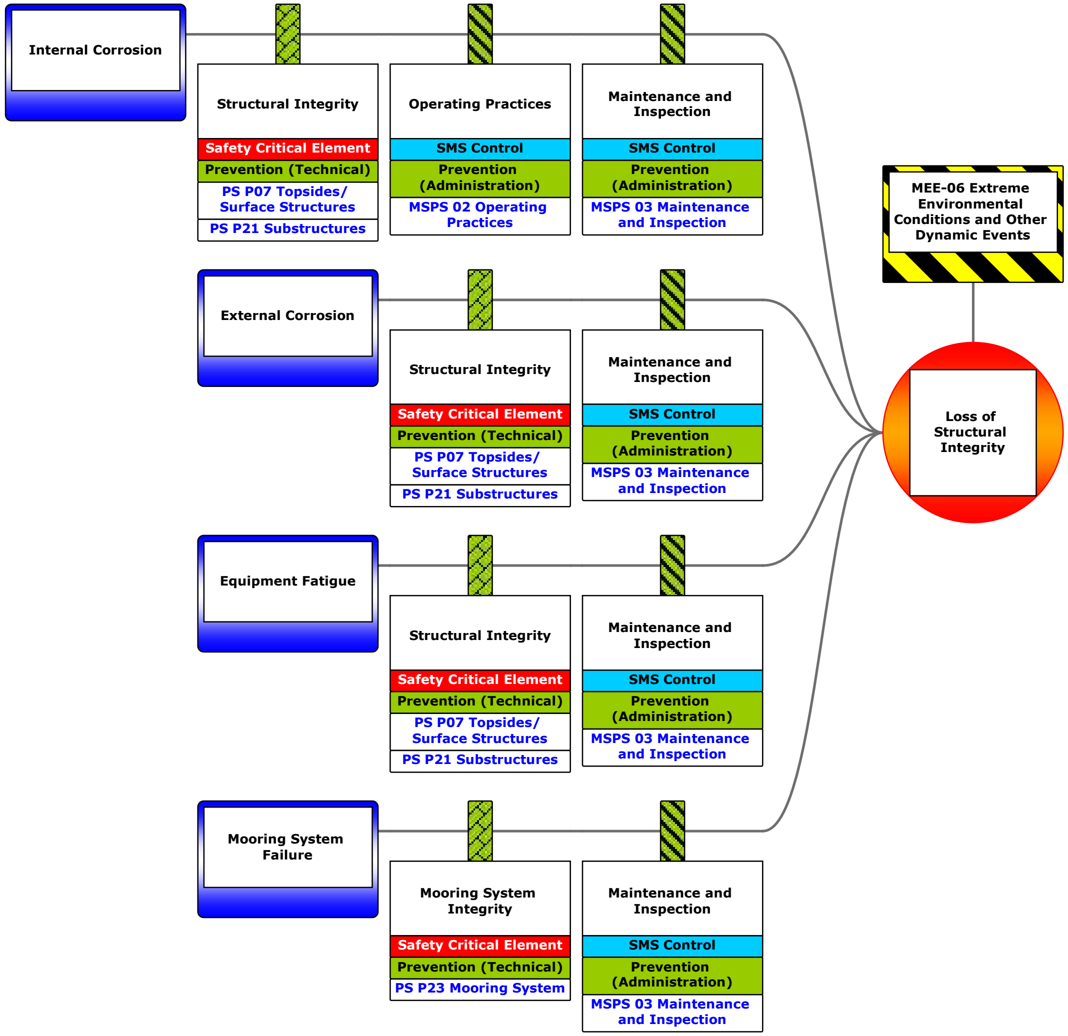

Figure 6-26: MEE-06 Loss of Structural Integrity (Causes 1–4)

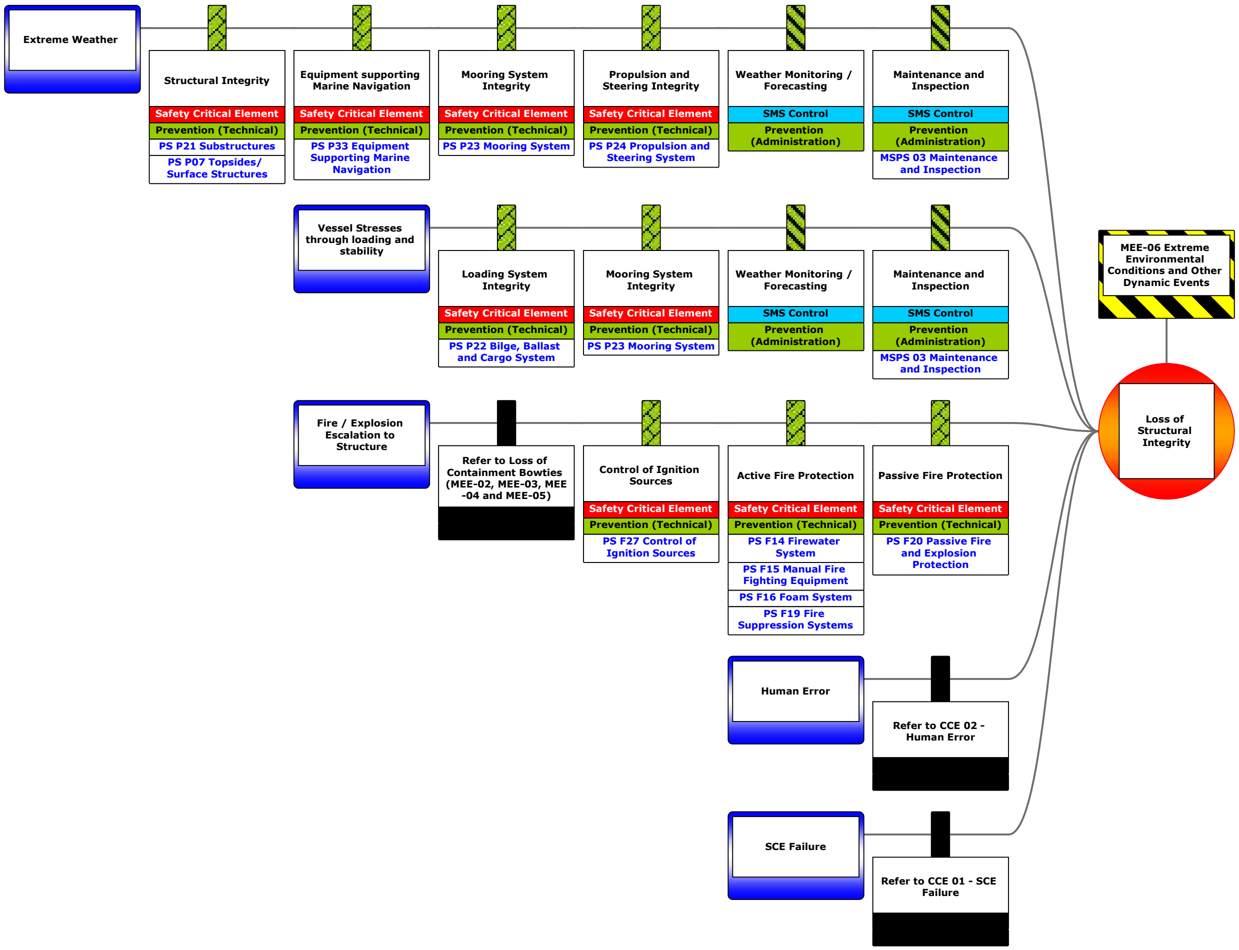

Figure 6-27: MEE-06 Loss of Structural Integrity (Causes 5–9)

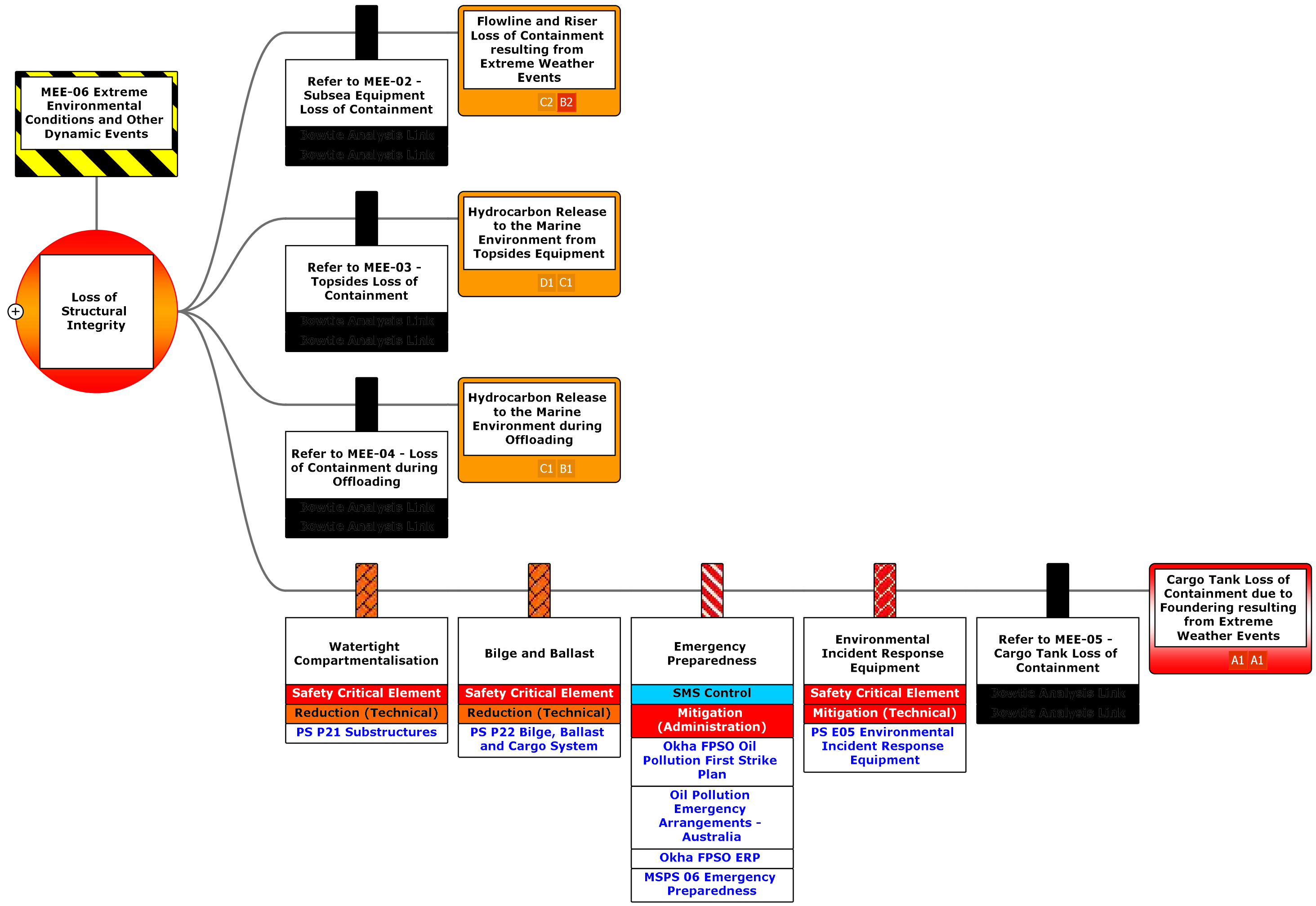

Figure 6-28: MEE-06 Loss of Structural Integrity (Outcomes)

MEE-06 Loss of Structural Integrity – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain structural integrity to ensure availability of critical systems during a major accident or environment event and prevent structural failures from contributing to escalation of a MEE.	P07 – Topsides Surface Structure P21 – Substructures P22 – Bilge, Ballast and Cargo Systems P23 – Mooring Systems P24 – Propulsion and Steering Systems P33 – Equipment Supporting Marine Navigation	Prevention (Technical)	Yes **C 17.1**
Engineering Controls	Maintain control of ignition sources and fire protection to prevent loss of structural integrity.	F14 – Firewater System F15 – Manual Fire Fighting Equipment F16 – Foam Systems F17 – Fire Water Pump F18 – Fire Main F19 – Fire Suppression Systems F20 – Passive Fire and Explosion Protection F27 – Control of Ignition Sources	Prevention (Technical)	Yes **C 17.2**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate response to accidents and emergencies	E04 – Safety Critical Communications	Mitigation (Technical)	Yes **C 12.2**
Engineering Controls	Maintain vessel stability and structural integrity to prevent structural failures from contributing to escalation of a MEE.	P21 – Substructures P22 – Bilge, Ballast and Cargo Systems	Reduction (Technical)	Yes **C 17.3**
Emergency Response	Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 12.4**
Legislation Codes and Standards				

MEE-06 Loss of Structural Integrity – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha facility to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks – describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP. Thus, contributing to management of associated potential environmental consequences of MAEs.	Okha Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 8.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections.	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Emergency Response and contingency planning	Implement management systems to maintain: • M06 – Emergency Preparedness • Okha Emergency Response Plan	MSPS 06 Okha Emergency Response Plan Okha Oil Pollution First Strike Plan (Appendix H)	Mitigation (Administration)	Yes – See Section 7 Refer to Appendix D for discussion around the

MEE-06 Loss of Structural Integrity – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	• Okha Oil Pollution First Strike Plan (Appendix H) • Oil Pollution Emergency Arrangements – Australia.	Oil Pollution Emergency Arrangements – Australia		ALARP assessment of controls related to hydrocarbon spill response.

Risk Based Analysis

For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7.3) has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

Application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-06; refer to Figure 6-26, Figure 6-27 and Figure 6-28 for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer Section 6.8.1).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

Societal Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a Remote likelihood unplanned hydrocarbon release as a result of a loss of structural integrity.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of Okha FPSO and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha FPSO Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and Management System Performance Standards (MSPS) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures and implementation of the Okha FPSO Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Loss of Structural Integrity is managed to ALARP.

Demonstration of Acceptability
Loss of structural integrity has been evaluated as having a 'High' level of risk rating (via the consideration of applicable MEEs). As per Section 2.8.2, Woodside considers 'High' risk ratings as acceptable if managed to ALARP. Due to the consequence associated with MEE-06, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the considerations described in Section 6.8.3 (MEE-01) (the considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 17 Structural integrity loss of containment risks to the environment limited to High through maintenance of prevention and mitigative barriers during the Petroleum Activities Program	**C 17.1** Maintain structural integrity to ensure availability of critical systems during a major accident or environment event and prevent structural failures from contributing to escalation of a MEE.	**PS 17.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P07 – Substructures and P21 – Topsides Surface Structure to both: – provide and maintain structural integrity to support SCE systems under all design conditions through service life – prevent structural failure from contributing to the escalation of a MEE by providing support/protection of SCE systems during an emergency event, and/or support containment of environmentally hazardous material. • P22 – Bilge, Ballast and Cargo Systems to: – maintain hull stress and vessel stability within integrity limits. • P23 – Mooring Systems to: – provide station, keeping within allowable excursion envelope – provide ability to disconnect facility from mooring on demand; and – provide ability to disconnect offtake tanker from facility on demand.	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		• P24 – Propulsion and Steering Systems and P33 – Equipment Supporting Marine Navigation to together (within Operational Area): – manoeuvre the facility under self-propulsion away from hazardous conditions – provide critical information to enable safe navigation of the FPSO; to allow the FPSO to disconnect and avoid adverse environmental conditions exceeding structural integrity limits.	
	C 17.2 Maintain control of ignition sources and fire protection to prevent loss of structural integrity.	**PS 17.2** Integrity will be managed in accordance with SCE management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F14 – Firewater System • F15 – Manual Fire Fighting Equipment • F16 – Foam Systems • F17 – Fire Water Pump • F18 – Fire Main • F19 – Fire Suppression Systems; to together: – provide reliable and secure delivery of firefighting medium (e.g. firewater, gaseous suppressant, foam) at the required flows, pressures, coverage and discharge rates to reduce the likelihood of escalation – where safe to do so, enable facility emergency response personnel to apply fire fighting medium to support fire control and limit escalation. • F20 – Passive Fire and Explosion Protection to: – mitigate the effects of a fire or explosion by maintaining the integrity	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		of critical structure and equipment and limiting the potential for escalation. • F27 – Control of Ignition Sources to: – prevent ignition of flammable or explosive atmospheres within identified Hazardous Areas.	
	Refer to **C 12.2**	Refer to **PS 12.2**	Refer to **MC 12.1**
	C 17.3 Maintain vessel stability and structural integrity to prevent structural failures from contributing to escalation of a MEE.	**PS 17.3** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P21 – Substructures: – to prevent structural failure from contributing to the escalation of a MEE by providing support/protection of SCE systems during an emergency event, and/or support containment of environmentally hazardous material. • P22 – Bilge, Ballast and Cargo Systems: – to maintain hull stress and vessel stability within integrity limits.	Refer to **MC 12.1**
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.9 Unplanned Hydrocarbon Release: Loss of Marine Vessel Separation (MEE-07)

Context		
Subsea Infrastructure – Section 3.5.3 Riser Turret Mooring System – Section 3.5.5 Vessels – Section 3.7 Subsea Inspection, Maintenance and Repair Activities – Section 3.10	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*							
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Hydrocarbon release caused by a loss of marine vessel separation, leading to: • MEE-02 – Subsea flowline and riser loss of containment • MEE-03 – Topsides loss of containment • MEE-04 – Offtake equipment loss of containment • MEE-05 – Okha FPSO Cargo tank loss of containment.	-	X	X	X	X	X	X	B	A	1	H	LC S GP PJ RB A CV SV	Acceptable if ALARP	EPO 18

Description of Source of Risk

Background

A loss of marine vessel separation between a vessel and the Okha FPSO may result in a loss of hydrocarbon containment from the Okha facility and/or the release of fuel from the vessel. A vessel collision with the Okha FPSO has been identified as a potential MEE (MEE-07). Vessel collisions can arise from:

- Visiting vessel collisions associated with support vessels and offtake tankers – ships which are visiting can accidentally collide with the Okha FPSO during approach to, or manoeuvring alongside, the FPSO.
- Errant passing vessel collision – ships which are not visiting the Okha FPSO (i.e. passing vessels) can, for one reason or another, move off-course and collide with the FPSO.

The different collision hazards involve significantly different sized vessels and collision speeds, hence, differing impact energies and consequences, and have been assessed.

<u>Visiting Vessels</u>

Visiting vessels are defined as those which are routinely used to service, or offtake cargo from, the Okha FPSO. Operating procedures will dictate how vessels are operated, loaded and unloaded, but it will generally occur so that the prevailing winds move the vessel away from the facility. The primary causes of visiting vessel collisions are failure to follow safe procedures and communication errors between the marine vessels and Okha operations. These errors could be worsened by vessel station keeping failures or operations in adverse weather conditions.

A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in Section 6.8.11.

Errant Passing Vessels

Errant passing vessels are defined as third-party vessels that enter the facility's 500 m PSZ, but do not call at Okha FPSO or other installations (i.e. not FPSO or subsea support vessels). The collision can be powered or drifting. Either has the potential to cause significant damage to the Okha FPSO.

The causes of errant passing vessel collisions include:

- failure of propulsion or steering systems
- adverse weather conditions resulting in poor visibility
- rough seas
- human error.

Woodside implement a range of control measures to mitigate the risk of errant vessel collision.

Loss of Vessel Separation – Credible Hydrocarbon Spill Scenario

A loss of marine vessel separation could result in a significant release of hydrocarbons. Hydrocarbon releases will result in a spill to the marine environment as described in Section 6.8.4 (MEE-02 – subsea flowline and riser loss of containment), Section 6.8.5 (MEE-03 – Topsides loss of containment), Section 6.8.6 (MEE-04 – Offtake equipment loss of containment) and Section 6.8.7 (MEE-05 – FPSO cargo tank loss of containment). Worst-case hydrocarbon release scenarios that could result from loss of marine vessel separation are discussed in the relevant sections referenced above. Relevant trajectory modelling, as applicable to these scenarios, is also discussed in the relevant sections. In addition, vessel cargo, including diesel inventory, could be spilled if the cause of the loss of facility integrity was a collision from a support vessel.

A loss of vessel separation may lead to the accidental release of diesel from the fuel tanks on the vessel(s) involved. For a vessel collision to result in the worst-case scenario of a hydrocarbon spill potentially impacting an environmental receptor, several factors must align as follows:

- vessel interaction must result in a collision
- the collision must have enough force to penetrate the vessel hull
- the collision must be in the exact location of the fuel tank
- the fuel tank must be full, or at least of volume which is higher than the point of penetration.

The probability of the chain of events described above aligning, to result in a breach of fuel tanks resulting in a spill that could potentially affect the marine environment is considered Highly Unlikely. Given the offshore location of the Operational Area, vessel grounding in relation to the Petroleum Activities Program is not considered a credible risk.

A collision between the Okha FPSO or subsea support vessel with a third-party vessel (i.e. commercial shipping, other petroleum related vessels and commercial fishing vessels) was considered the only credible event that could release a significant quantity of diesel to the environment. This was assessed as being credible but Highly Unlikely given:

- the facility support vessels typically operate close to the Okha FPSO (an area avoided by commercial shipping and fishing)
- the presence of subsea vessels in the Operational Area is typically temporary (e.g. while undertaking IMMR activities)
- vessels undertaking the Petroleum Activities Program typically operate of low speeds or are stationary
- the standard vessel operations and equipment in place to prevent collision at sea, and the construction and placement of storage tanks.

In the unlikely event of a collision between the Okha FPSO or subsea support vessel with a third-party vessel, the maximum volume likely to be released from rupture of a vessel diesel fuel tank has been estimated to be 105 m^3. This is based on the wing tank of support vessels holding ~100 m^3 to 120 m^3 diesel, the fuel tank is full, and a conservative assumption that that 80% of the diesel fuel would spill to the marine environment. Release characteristics for a vessel diesel fuel tank loss of containment scenario are summarised in Table 6-26.

Table 6-29: Summary of the worst-case vessel diesel fuel tank loss of containment release scenario

Scenario	Hydrocarbon	Duration (hours)	Depth (m)	Latitude (WGS84)	Longitude (WGS84)	Total Diesel Release Volume (m^3)
Vessel diesel fuel tank loss of containment	Diesel	Instantaneous	Surface	19° 35' 21" S	116° 26' 48" E	105 m^3

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in FPSO operation. In the company's 60-year history, it has not experienced any loss of vessel separation events that have resulted in significant releases or significant environmental impacts. The Okha facility has never experienced a worst-case hydrocarbon release from a loss of vessel separation in its operational history.

Decision Type

Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk-based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling. Company and societal values were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation.

A loss of marine vessel separation is considered a MEE (MEE-07). The hazard associated with this MEE is the hydrocarbon inventory on the Okha FPSO, subsea flowlines and riser, and fuel onboard vessels.

Quantitative Spill Risk Assessment

Credible worst-case hydrocarbon scenarios for MEE-02, MEE-03, MEE-04 and MEE-05 are considered to apply to a loss of marine vessel separation, as they may credibly arise from damage to the Okha facility and loss of vessel fuel.

Refer to Sections 6.8.4, 6.8.5, 6.8.6, and 6.8.7 for additional information on quantitative spill risk assessments for these scenarios.

Spill modelling of the worst-case credible loss of vessel diesel fuel was undertaken by RPS, on behalf of Woodside, to determine the fate of hydrocarbons released based on the assumptions in Section 6.8.1. Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volumes for all loss of well containment scenarios.

Consequence

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a loss of vessel separation. These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS APASA, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.3) and relevant literature and studies considering the effects of hydrocarbon exposure.

Likelihood

In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance, infrastructure marked on marine charts), the likelihood has been taken as Highly Unlikely (1).

Consequence Assessment

Environment that May Be Affected

As discussed under Description of Source of Risk, the potential impacts from hydrocarbon release caused by a loss of marine separation are those which would result from:

- Subsea Equipment Loss of Containment, Section 6.8.4 (MEE-02)
- Topsides Loss of Containment, Section 6.8.5 (MEE-03)
- Offtake Equipment Loss of Containment, Section 6.8.6 (MEE-04)
- Cargo Tank Loss of Containment, Section 6.8.7 (MEE-05).

The potential impacts are therefore discussed in the above mentioned sections.

Potential impacts relating to a vessel diesel fuel tank loss of containment are discussed in the following sections below.

Surface Hydrocarbons

The modelled surface hydrocarbons are forecast to drift down current of the release location with the trajectory dependent on prevailing wind and current conditions at the time. Modelling results indicate no contact with sensitive receptors by surface (floating) hydrocarbons above the EMBA impact threshold (10 g/m^2) or Socio-cultural EMBA threshold (1 g/m^2) at probabilities of 1% or greater.

Entrained Hydrocarbons

Modelling results indicate no contact with sensitive receptors by entrained hydrocarbons above impact the threshold (500 ppb) at probabilities of 1% or greater.

Consequence Assessment
<u>Dissolved Hydrocarbons</u> Modelling results indicate no contact with sensitive receptors by dissolved hydrocarbons above the impact threshold (500 ppb) at probabilities of 1% or greater. <u>Accumulated Hydrocarbons</u> Modelling results indicate no contact with sensitive receptors by accumulated shoreline hydrocarbons above the impact threshold (100 g/m^2) at probabilities or 1% of greater, with a maximum accumulated volume of <1 m^3 along all shoreline receptors. ***Consequence Assessment Summary*** Modelling of the credible worst-case hydrocarbon spill scenario that may arise from MEE-05 (discussed in Section 6.8.7) indicates that the spill may impact upon a number of environmental receptors (Table 6-27). The biological consequences of such a spill on identified open water sensitive receptors relate to the potential for catastrophic, long-term impacts to environmental receptors within the spill affected area. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01 (Section 6.8.3). Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01 (Section 6.8.3).

MEE-07 Loss of Marine Vessel Separation – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-07; refer to Figure 6-29 and Figure 6-30 for bowtie diagrams.

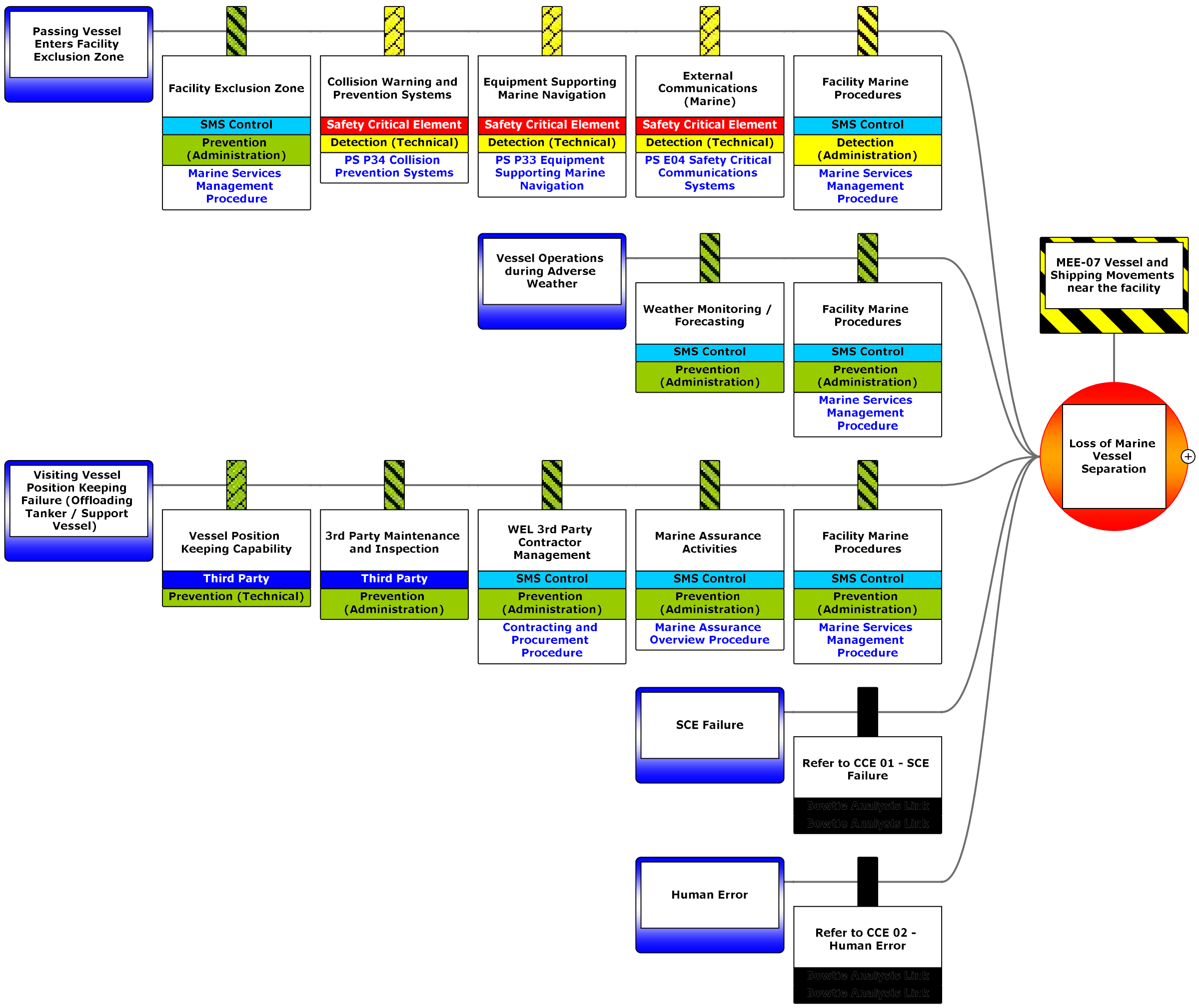

Figure 6-29: MEE-07 Loss of Marine Vessel Separation (Causes 1–5)

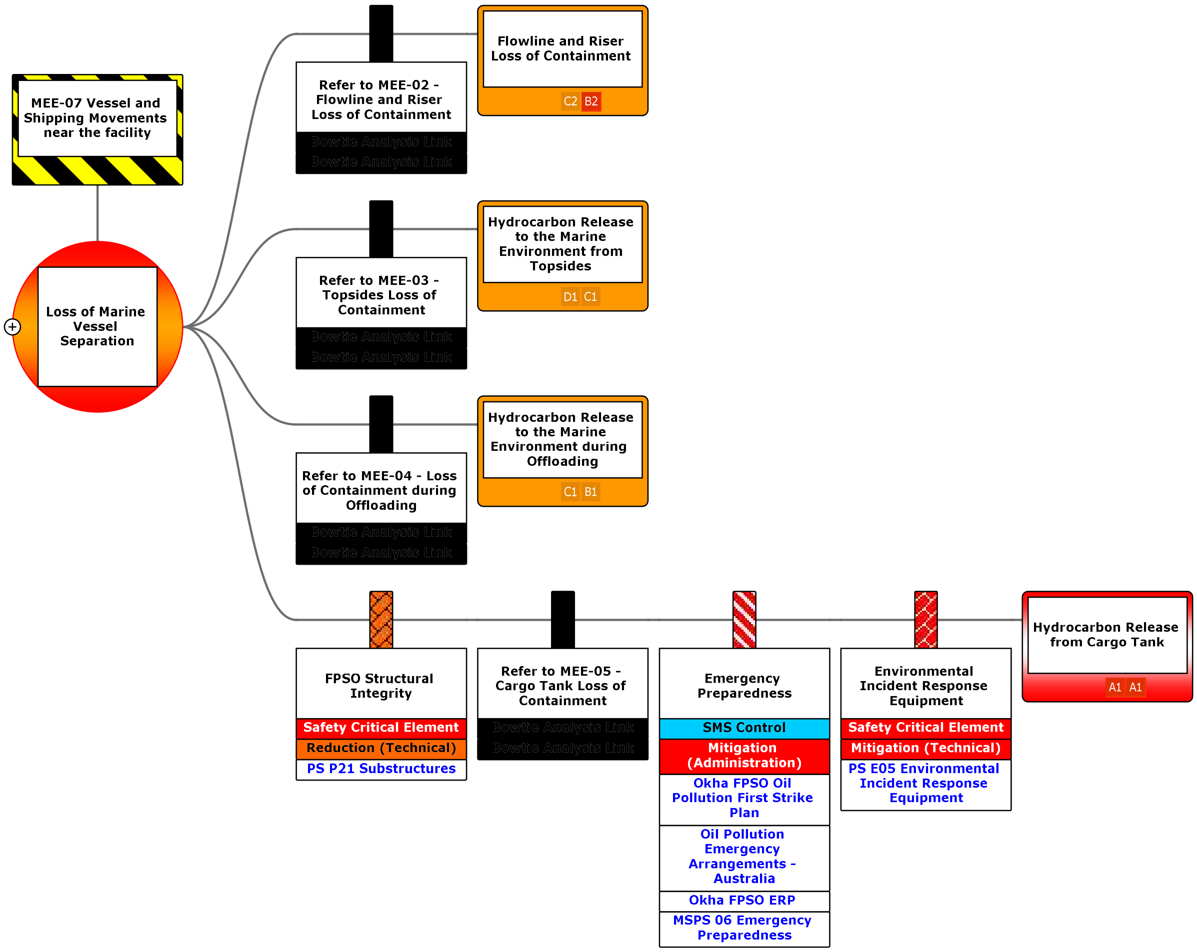

Figure 6-30: MEE-07 Loss of Marine Vessel Separation (Outcomes)

<table>
<tr><th colspan="5">MEE-07 Loss of Marine Vessel Separation – Demonstration of ALARP
Control Measures</th></tr>
<tr><th>Hierarchy</th><th>Control / Barrier</th><th>SCE / Management System Reference</th><th>Type of Effect (Table 6-21)</th><th>Control Adopted</th></tr>
<tr><td colspan="5">Preventive Barriers – Safety and Environmental Critical Elements</td></tr>
<tr><td>Elimination</td><td rowspan="2">n/a</td><td colspan="3" rowspan="2">No elimination or substitution controls were identified beyond those incorporated in design.</td></tr>
<tr><td>Substitution</td></tr>
<tr><td>Engineering Controls</td><td>Maintain collision warning systems and navigational aids and critical communications systems to alert facility of a potential collision with marine vessels, and to alert marine vessels of facility location so that they may take timely action to avoid the facility and hence reduce likelihood of collision.</td><td>P34 – Collision Prevention Systems
P33 – Equipment Supporting Marine Navigation
E04 – Safety Critical Communications</td><td>Detection
(Technical)</td><td>Yes
C 18.1</td></tr>
<tr><td colspan="5">Mitigating Barrier – Safety and Environmental Critical Elements</td></tr>
<tr><td>Engineering Controls</td><td>Maintain hull structural integrity to prevent structural failures as a result of ship collision from contributing to escalation of a MEE.</td><td>P21 – Substructures</td><td>Reduction
(Technical)</td><td>Yes
C 18.2</td></tr>
<tr><td>Emergency Response</td><td>Maintain environmental incident response equipment to enact the Okha Oil Pollution First Strike Plan (Appendix H).</td><td>E05 – Environmental Incident Response Equipment</td><td>Mitigation (Technical)</td><td>Yes
C 12.4</td></tr>
<tr><td colspan="5">Legislation Codes and Standards</td></tr>
<tr><td>Procedures and Administration</td><td>Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009:
• Accepted Safety Case for the Okha facility to:
– identify hazards that have the potential to cause a MAE
– detail assessment of MAE risks
– describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP.</td><td>Okha Safety Case</td><td>Prevention (Administration)
Control based on legislative requirements – must be adopted</td><td>Yes
C 12.6</td></tr>
</table>

MEE-07 Loss of Marine Vessel Separation – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	Thus, contributing to management of associated potential environmental consequences of MAEs.			
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements. Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Yes **C 8.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • Contracting and Procurement Procedure • Marine Assurance Overview Procedure • Marine Services Management Procedure.	Marine Services Management Procedure Marine Assurance Overview Procedure Contracting and Procurement Procedure	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Emergency Response and contingency planning	Implement management systems to maintain: • M06 – Emergency Preparedness • Okha Emergency Response Plan • Okha Oil Pollution First Strike Plan (Appendix H) • Oil Pollution Emergency Arrangements – Australia.	MSPS 06 Okha Emergency Response Plan Okha Oil Pollution First Strike Plan (Appendix H) Oil Pollution Emergency Arrangements – Australia	Mitigation (Administration)	Yes – See Section 7 Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.
Risk Based Analysis				
For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7.3, has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following				

MEE-07 Loss of Marine Vessel Separation – Demonstration of ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***

hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

Application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-07; refer to Figure 6-29 and Figure 6-30 for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer Section 6.8.1).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

Societal Values

Refer to Societal Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a Remote likelihood unplanned hydrocarbon release as a result of a loss of marine vessel separation.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of the Okha FPSO and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and Management System Performance Standards (MSPS) for Safety Critical Procedures.

The application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, alongside procedural control of Okha FPSO operations, it is considered that MEE risk associated with loss of marine vessel separation is managed to ALARP.

Demonstration of Acceptability

Loss of marine vessel separation has been evaluated as having a ‘High’ risk rating (via the consideration of applicable MEEs). As per Section 2.8.2, Woodside considers ‘High’ risk ratings acceptable if managed to ALARP. Due to the consequence associated with MEE-07, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in Section 6.8.3 (MEE-01) (the considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 18 Loss of marine vessel separation risks to the environment limited to High through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 18.1** Maintain collision warning systems and navigational aids to alert facility of a potential collision with marine vessels, and to alert marine vessels of facility location so that they may take timely action to avoid the facility and hence reduce likelihood of collision.	**PS 18.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P34 – Collision Prevention Systems to: – alert facility of a potential collision with marine vessels – alert marine vessels of facility location so that they may take timely action to avoid the facility and hence reduce likelihood of collision. • P33 – Equipment Supporting Marine Navigation to: – provide critical information to enable safe navigation of the NY FPSO in disconnected mode to avoid a MEE. • E04 – Safety Critical Communications to: – allow effective ER communications in emergencies, including: o internal communications such as audible and visual warning systems, and voice communications during emergency events o external communications such as voice communications to adjacent facilities, aircraft and vessels, and external incident control centres during emergency events.	Refer to **MC 12.1**
	C 18.2 Maintain hull structural integrity to prevent	**PS 18.2** Integrity will be managed in accordance with SCE	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	structural failures as a result of ship collision from contributing to escalation of a MEE.	Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P21 – Substructures to: – provide and maintain structural integrity to support SCE systems under all design conditions through service life – prevent structural failure from contributing to the escalation of a MEE by providing support/ protection of SCE systems during an emergency event, and/or support containment of environmentally hazardous material.	
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.10 Unplanned Hydrocarbon Release: Loss of Control of Suspended Load from Okha Lifting Operations (MEE-08)

Context		
Lifting Operations – Section 3.6.9.1	Physical Environment – Section 4.4 Biological Environment – Section 4.5 Socioeconomic and Cultural – Section 4.6 Values and Sensitivities – Section 4.7	Stakeholder Consultation – Section 5

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socioeconomic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tools	Acceptability	Outcome
Hydrocarbon release from subsea equipment to the marine environment and atmosphere (MEE-02).	-	X	X	X	X	X	X	B	C	1	M	LCS GP PJ RBA CV	Acceptable if ALARP	EPO 19
Hydrocarbon release from topsides equipment to the marine environment and atmosphere (MEE-03).	-	X	X	X	X	X	X	B	D	1	M			

Description of Source of Risk

Background

The Okha FPSO is equipped with four rotating cranes and one overhead crane. Lifting takes place between supply vessels and laydown areas or between laydown areas. The main deck cranes are equipped with 'lock-out' zones, to prevent lifting over sensitive areas or equipment without additional controls being implemented and to eliminate the potential for a crane to strike other structures or obstacles, such as the flare tower or Accommodation block.

Lifting operations performed using the Okha FPSO or visiting vessel cranes could potentially lead to dropped objects impacting assets (topsides equipment, subsea infrastructure) inside the Okha FPSO 500 m PSZ. This may lead to a hydrocarbon loss of containment from topsides or subsea infrastructure. Loss of suspended load has been identified as a MEE (MEE-08). A loss of suspended load may arise from:

- lifting equipment failure
- facility lifting operations.

A number of common failure causes due to human error and SCQ failures are presented in the generic Human Error and SCE failure bowties in Section 6.8.11.

Loss of Suspended Load – Credible Hydrocarbon Spill Scenario

The potential outcome of a loss of control of a suspended load is a topsides and/or subsea flowlines and riser loss of containment. Refer to Section 6.8.4 and Section 6.8.5 for a description of subsea equipment and topsides loss of containments scenarios, respectively.

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in FPSO operation. In the company's 60-year history, it has not experienced any loss of control of suspended load events that have resulted in significant releases or significant environmental impacts.

<u>Decision Type</u>

Decision Type B has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk-based tools including the bowtie methodology (described in Section 2.7.3) and hydrocarbon spill trajectory modelling. Company values were also considered in the demonstration of ALARP and acceptability.

The release of hydrocarbons as a result of subsea loss of containment is considered a MEE (MEE-08). The hazard associated with this MEE is the hydrocarbon inventory of subsea flowlines and risers, or topsides process and non-process hydrocarbons equipment.

Note that Woodside has assessed the environment consequence of a worst-case credible loss of containment from subsea equipment (refer MEE-02) as 'C' as per the Woodside Risk Matrix. Woodside has also assessed the reputational and brand consequences associated with this release and concluded that the event results in a 'B' level consequence, and hence meets Woodside's definition of a MEE (refer to Section 2.7.2).

<u>Quantitative Spill Risk Assessment</u>

Credible worst-case hydrocarbon scenarios for MEE-02 and MEE-03 are considered to apply to a loss of control of suspended load, as they may credibly arise from damage to hydrocarbon containing subsea infrastructure within the 500 m PSZ and Okha FPSO topsides infrastructure. Refer to Sections 6.8.4 and 6.8.5 for additional information on quantitative spill risk assessments for these scenarios.

<u>Consequence</u>

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case loss of suspended load. These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (Section 6.8.1) and relevant literature and studies considering the effects of hydrocarbon exposure.

<u>Likelihood</u>

In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e. design, inspection and maintenance), the likelihood has been taken as Highly Unlikely (1).

Consequence Assessment

As discussed under Description of Source of Risk, the potential impacts from hydrocarbon release caused by a loss of control of suspended load are those which would result from:

- Subsea Equipment Loss of Containment, Section 6.8.4 (MEE-02)
- Topsides Loss of Containment, Section 6.8.5 (MEE-03).

The potential impacts are therefore discussed in the above mentioned sections.

MEE-08 Loss of Control of Suspended Load from Okha Lifting Operations – Risk Analysis

Bowtie risk analysis was undertaken to assess MEE-06; refer to Figure 6-26, Figure 6-27, Figure 6-29, and Figure 6-30 for bowtie diagrams.

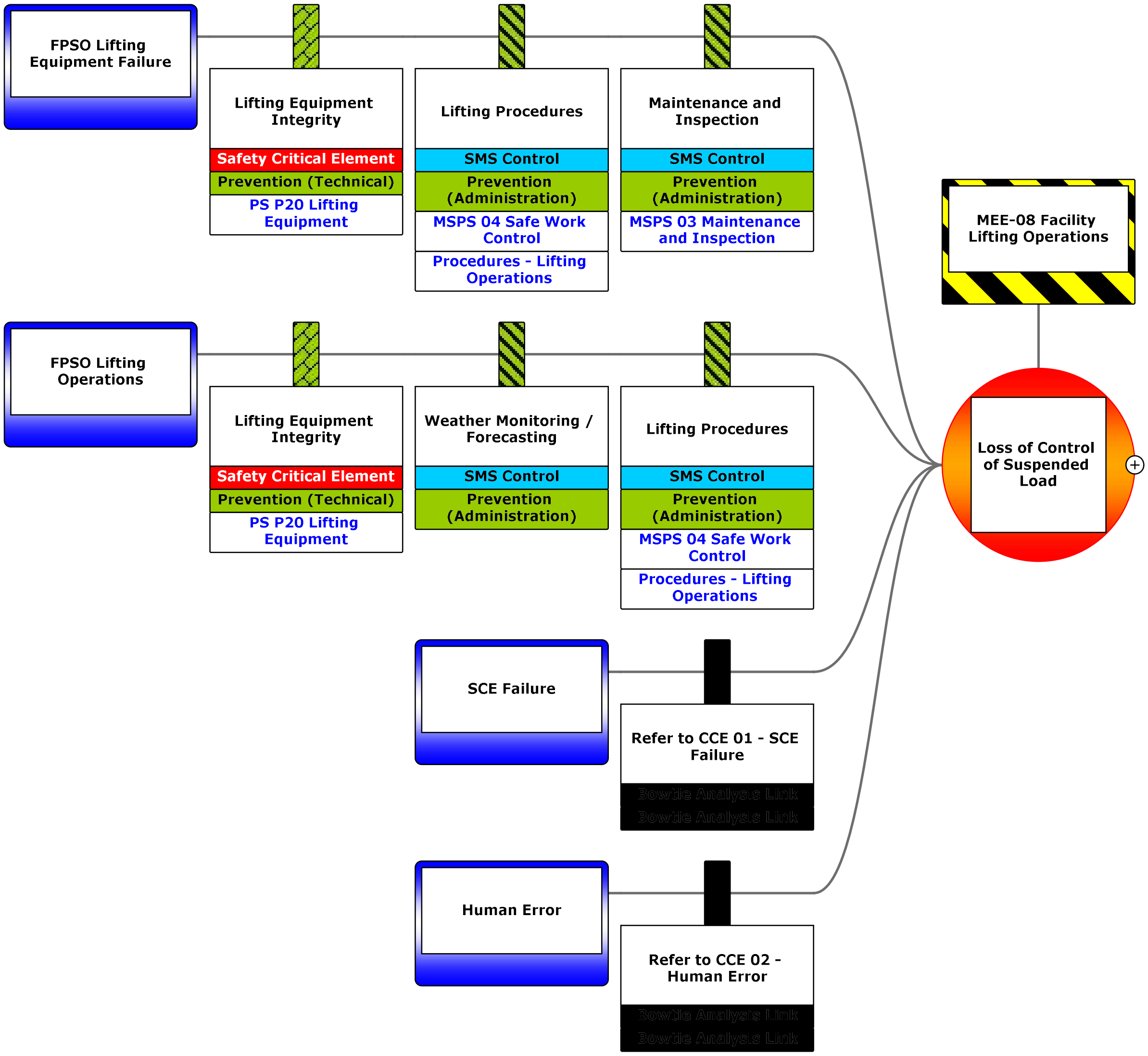

Figure 6-31: MEE-08 Loss of Control of Suspended Load from Okha Lifting Operations (Causes 1–4)

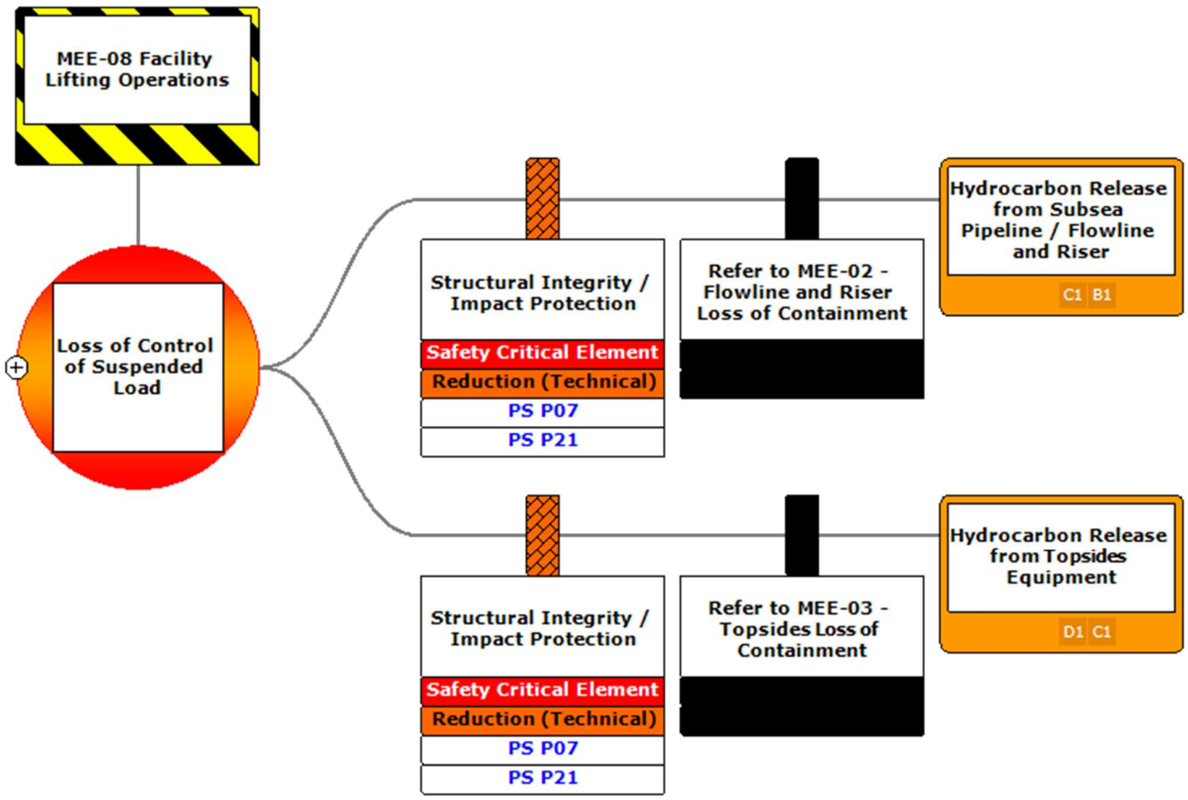

Figure 6-32: MEE-08 Loss of Control of Suspended Load from Okha Lifting Operations (Outcomes)

MEE-08 Loss of Control of Suspended Load from FPSO – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain integrity of FPSO lifting equipment to prevent lifting equipment failure or dropped/swinging loads that could result in a MEE.	P20 – Lifting Equipment	Prevention (Technical)	Yes **C 19.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Impact Protection	Maintain structural integrity (impact protection) to ensure availability of critical systems during a major accident or environment event and prevent structural failures from contributing to escalation of a MEE.	P07 – Topsides Surface Structure P21 – Substructures	Reduction (Technical)	Yes **C 19.2**
Emergency Response	Maintain environmental incident response equipment to enact the Okha Pollution First Strike Plan.	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 12.4**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha facility to: – identify hazards that have the potential to cause a MAE – detail assessment of MAE risks – describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP.	Okha Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**

MEE-08 Loss of Control of Suspended Load from FPSO – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***
	Thus, contributing to management of associated potential environmental consequences of MAEs.			
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements. Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Yes **C 8.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • Engineering Standard Lifting Equipment • MSPS 03 Maintenance and Inspection • MSPS 04 Safe Work Control • Procedures – Lifting Operations.	Engineering Standard Lifting Equipment MSPS 03 Maintenance and Inspection MSPS 04 Safe Work Control Lifting Operations Procedure	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Emergency Response and Contingency Planning	Implement management systems to maintain: • M06 – Emergency Preparedness • Okha Emergency Response Plan • Okha Oil Pollution First Strike Plan (Appendix H) • Oil Pollution Emergency Arrangements – Australia.	MSPS 06 – Emergency Preparedness Okha ERP Okha Oil Pollution First Strike Plan (Appendix H) Oil Pollution Emergency Arrangements – Australia	Mitigation (Administration)	Yes – See Section 7 Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.
Risk Based Analysis				
For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7.3), has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following				

MEE-08 Loss of Control of Suspended Load from FPSO – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Table 6-21)***	***Control Adopted***

hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

Application of Woodside Risk Management Procedures and implementation of the Okha FPSO Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-08; refer to Figure 6-31 and Figure 6-32 for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer Section 6.8.1).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

Societal Values

Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a Highly Unlikely likelihood unplanned hydrocarbon release as a result of a loss of control of suspended load.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of the Okha FPSO and ensuring the equipment is operated within the design envelope through operating practices and assurance through maintenance and inspection. If a loss of control of suspended load occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the Okha Safety Case, SCE management procedures including technical performance standards for SCEs and MSPS for Safety Critical Procedures.

The application of Woodside Risk Management Procedures and implementation of the Okha Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, alongside procedural control of Okha operations, it is considered that MEE risk associated with Loss of Control of Suspended Load is managed to ALARP.

Demonstration of Acceptability

Loss of suspended load has been evaluated as having a ‘Moderate’ risk rating (via the consideration of applicable MEEs). As per Section 2.8.2, Woodside considers ‘Moderate’ risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-08, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in Section 6.8.3 (MEE-01) (the considerations include principles of ESD, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 19 Loss of suspended load from OKHA FPSO risks to the environment limited to High through maintenance of prevention and mitigative barriers during the Petroleum Activities Program.	**C 19.1** Maintain integrity of FPSO lifting equipment to prevent lifting equipment failure or dropped/swinging loads that could result in a MEE.	**PS 19.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P20 – Lifting Equipment to: – prevent lifting equipment failure or dropped/swinging loads that could result in a MEE by maintaining lifting equipment integrity.	Refer to **MC 12.1**
	C 19.2 Maintain structural integrity (impact protection) to ensure availability of critical systems during a major accident or environment event and prevent structural failures from contributing to escalation of a MEE.	**PS 19.2** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P07 – Topsides Surface Structure and P21 – Substructures to: – provide and maintain structural integrity to support SCE systems under all design conditions through service life – prevent structural failure from contributing to the escalation of a MEE by providing support/protection of SCE systems during an emergency event, and/or support containment of environmentally hazardous material.	Refer to **MC 12.1**
	Refer to **C 12.4**	Refer to **PS 12.4**	Refer to **MC 12.1**
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Refer to **C 8.5**	Refer to **PS 8.5**	Refer to **MC 8.5**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

6.8.11 MEE Common Cause Event Failure Mechanisms: SCE Failure CCE-01 and Human Error CCE-02

This section presents common mode failure causes and controls applicable across MEEs, which are also observed within the bowties of the MEEs discussed within sections above. Controls, EPSs and MC presented within this section are also considered relevant to MEE-01 to MEE-08.

Okha: Major Environment Event Datasheet	
MEE Number	All
Hazard Description	Generic SCE failure
Hazard Description	
Hazard Overview and Scope	
There are a number of causes which contribute to failures of SCEs and other systems which might protect against a MEE. These include: • maintenance errors • defects • electrical supply failure • hydraulic supply failure • adverse environmental conditions. The generic SCE failure bowtie (Figure 6-33 and Figure 6-34) illustrates the causes, outcomes and the controls in place to manage these failure mechanisms.	

Hazard Management (Bowtie Diagrams)

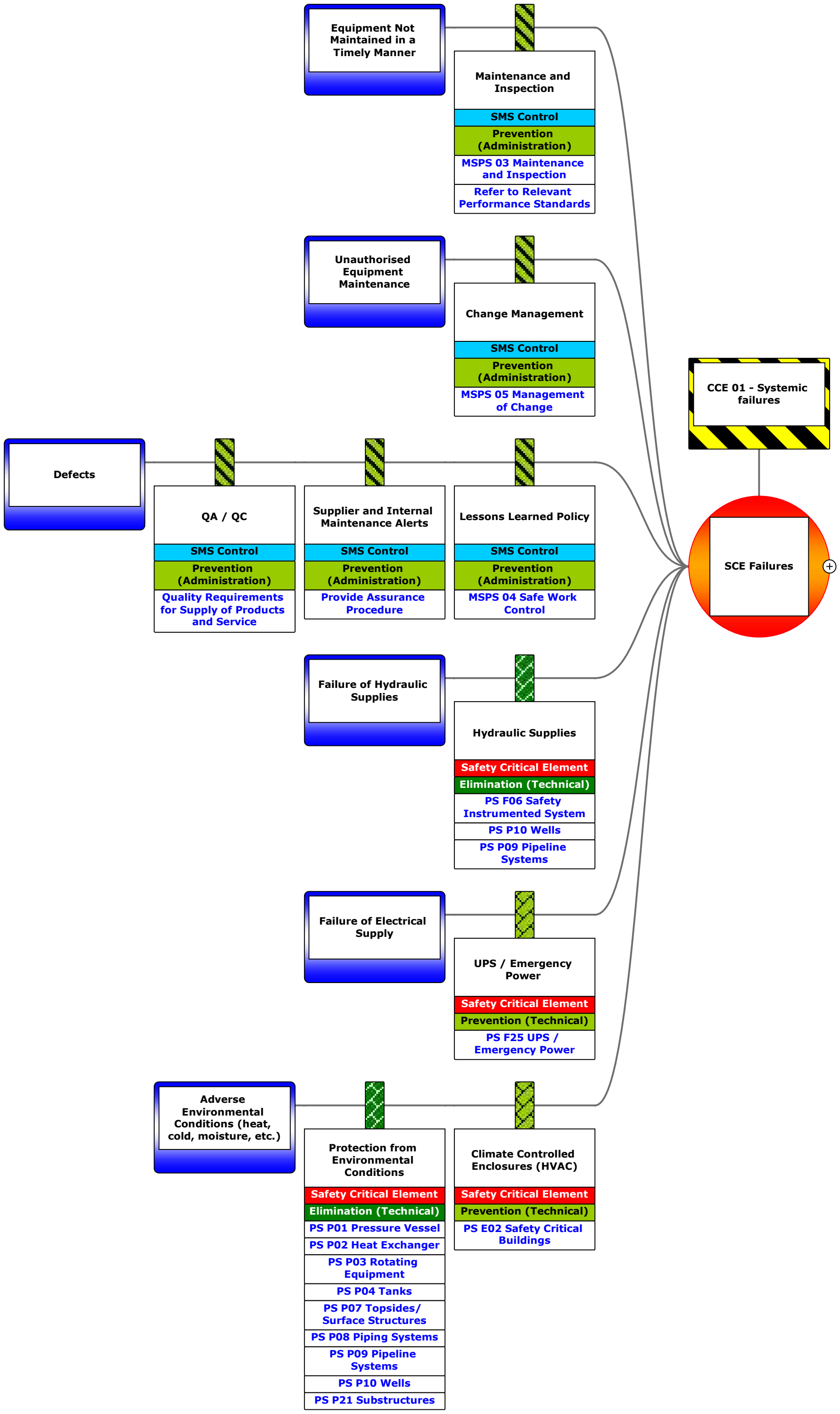

Figure 6-33: Generic Bowtie – SCE Failures (Causes)

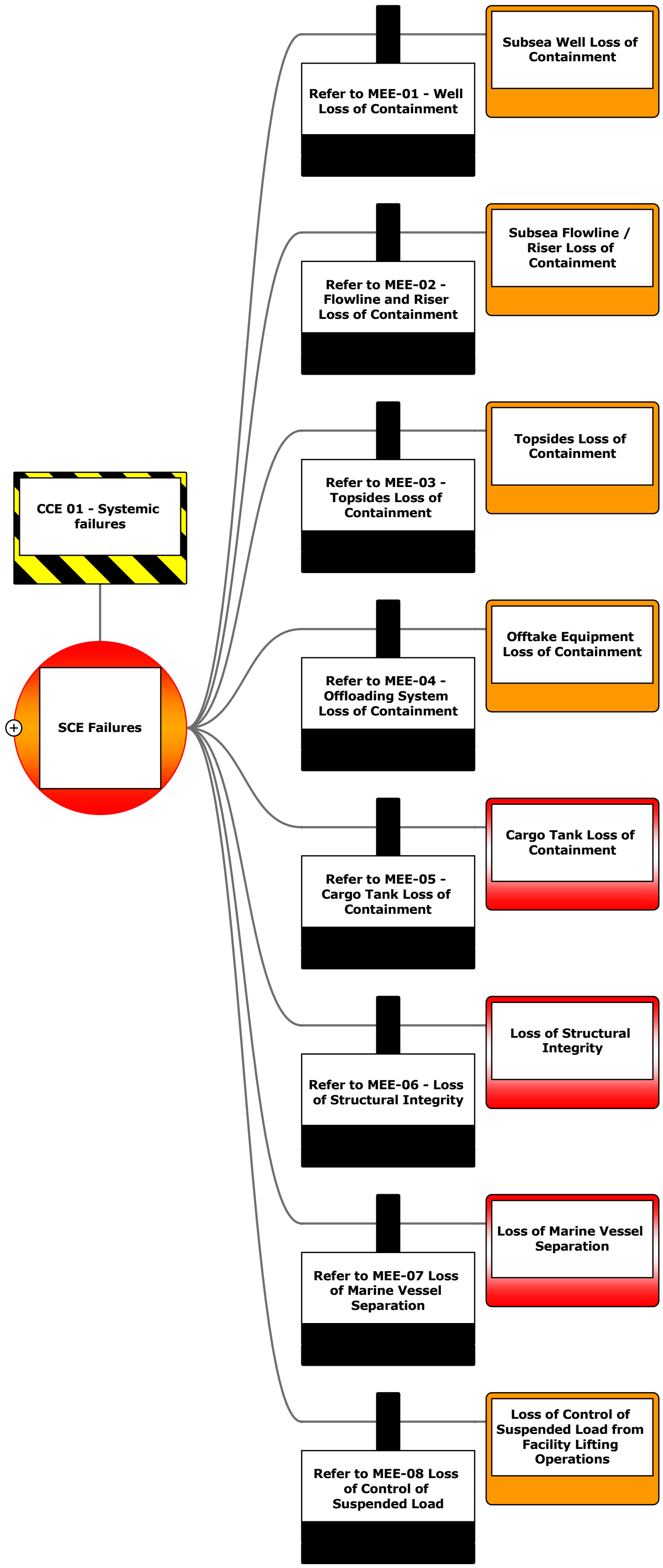

Figure 6-34: Generic Bowtie – SCE Failures (Outcomes)

CCE-01 Safety Critical Equipment Failure Risk Analysis and Demonstration of ALARP ALARP Control Measures				
Hierarchy	**Control / Barrier**	**SCE / Management System Reference**	**Type of Effect (Table 6-21)**	**Control Adopted**
Preventive Barriers – Safety and Environmental Critical Elements				
Elimination	Maintain hydraulic supplies (e.g. to support Safety Instrumented Systems and actuation of SCE valves/isolations).	F06 – Safety Instrumented System P10 – Wells	Elimination (Technical)	Yes **C 20.1**
	Maintain protection from environmental conditions.	P01 – Pressure Vessel P02 – Heat Exchanger P03 – Rotating Equipment P07 – Topsides Surface Structure P08 – Piping Systems P09 – Pipeline Systems P10 – Wells P21 – Substructures	Elimination (Technical)	Yes **C 20.2**
Substitution	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Engineering Controls	Maintain UPS / emergency power system to supply Essential safety systems.	F25 – UPS / Emergency Generation Systems	Prevention (Technical)	Yes **C 20.3**
	Maintain climate controlled enclosures to protect essential equipment from adverse environmental conditions.	E02 – Temporary Refuge	Prevention (Technical)	Yes **C 20.4**
Mitigating Barrier – Safety and Environmental Critical Elements				
Mitigation	n/a	No mitigation controls were identified beyond those incorporated in design.		
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: • Accepted Safety Case for the Okha facility to; – identify hazards that have the potential to cause a MAE; – detail assessment of MAE risks; and – describe the physical barriers SCEs and the safety	Okha Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 12.6**

CCE-01 Safety Critical Equipment Failure Risk Analysis and Demonstration of ALARP ALARP Control Measures				
Hierarchy	**Control / Barrier**	**SCE / Management System Reference**	**Type of Effect (Table 6-21)**	**Control Adopted**
	management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus, contributing to management of associated potential environmental consequences of MAEs.			
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • MSPS 03 Maintenance and Inspection • MSPS 04 Safe Work Control • MSPS 05 Management of Change • Quality Requirements for Supply of Products and Service • Provide Assurance Procedure	• MSPS 03 Maintenance and Inspection • MSPS 04 Safe Work Control • MSPS 05 Management of Change • Quality Requirements for Supply of Products and Service • Provide Assurance Procedure)	Prevention (Administration)	Yes – See Section 7 Implementation Strategy.
Risk Evaluation				
Refer to MEEs.				

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
Refer to relevant MEE EPOs: • **EPO 12** • **EPO 13** • **EPO 14** • **EPO 15** • **EPO 16** • **EPO 17** • **EPO 18** • **EPO 19**	**C 20.1** Maintain hydraulic supplies (e.g. to support Safety Instrumented Systems and actuation of SCE valves/isolations).	**PS 20.1** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System; and P10 – Wells to together: – maintain hydraulic supplies (e.g. to support Safety Instrumented Systems and actuation	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		of SCE valves/isolations).	
	C 20.2 Maintain protection from environmental conditions.	**PS 20.2** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P01 – Pressure Vessel • P02 – Heat Exchanger • P03 – Rotating Equipment • P04 – Tanks • P07 – Topsides Surface Structure • P08 – Piping Systems • P09 – Pipeline Systems • P10 – Wells • P21 – Substructures for each SCE to protect equipment from adverse environmental conditions (e.g. heat, cold, moisture, chemical reaction/incompatibility).	Refer to **MC 12.1**
	C 20.3 Maintain UPS / emergency power system to supply Essential safety systems.	**PS 20.3** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F25 – UPS/Emergency Generation Systems – to provide continuous supply of power (emergency generation and UPS to Essential loads following a total (mains) power failure.	Refer to **MC 12.1**
	C 20.4 Maintain climate controlled enclosures to protect essential equipment from adverse environmental conditions.	**PS 20.4** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • E02 – Temporary Refuge – to protect essential equipment from adverse environmental	Refer to **MC 12.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		conditions/fire and explosion.	
	Refer to **C 12.6**	Refer to **PS 12.6**	Refer to **MC 12.6**
	Mitigation – hydrocarbon spill response	Refer to Appendix D for discussion around the ALARP assessment of controls related to hydrocarbon spill response.	

Okha: Major Environmental Event Datasheet	
MEE Number	ALL
Hazard Description	Generic Human Errors – Degradation Factors
Hazard Ref ID	N/A

HAZARD DESCRIPTION

Hazard Overview

There are a number of causes of human errors which contribute to MEEs, or which can result in failure or degradation of the barriers in place to protect against MEEs. These are presented in the following bowtie pages and include:

- task issues, e.g. poor task design; time pressures, task complexity
- poor physical interfaces / working environment
- provision of inappropriate tools for the task
- communication errors, i.e. poor-quality information, lack of clarity in instructions
- operator failings, e.g. competence, fitness, impairment or fatigue
- organisational issues, e.g. peer pressure, poor safety culture, inadequate supervision, lack of clarity on roles and expectations.

The Generic Human Errors bowtie illustrates the causes, outcomes and the barriers in place for these failure mechanisms. Human Errors are managed solely via the WMS (no SCEs) and the bowtie is included in this section for completeness. Refer to Section 7 for applicable Management System Procedures.

HAZARD MANAGEMENT (BOWTIE DIAGRAMS)

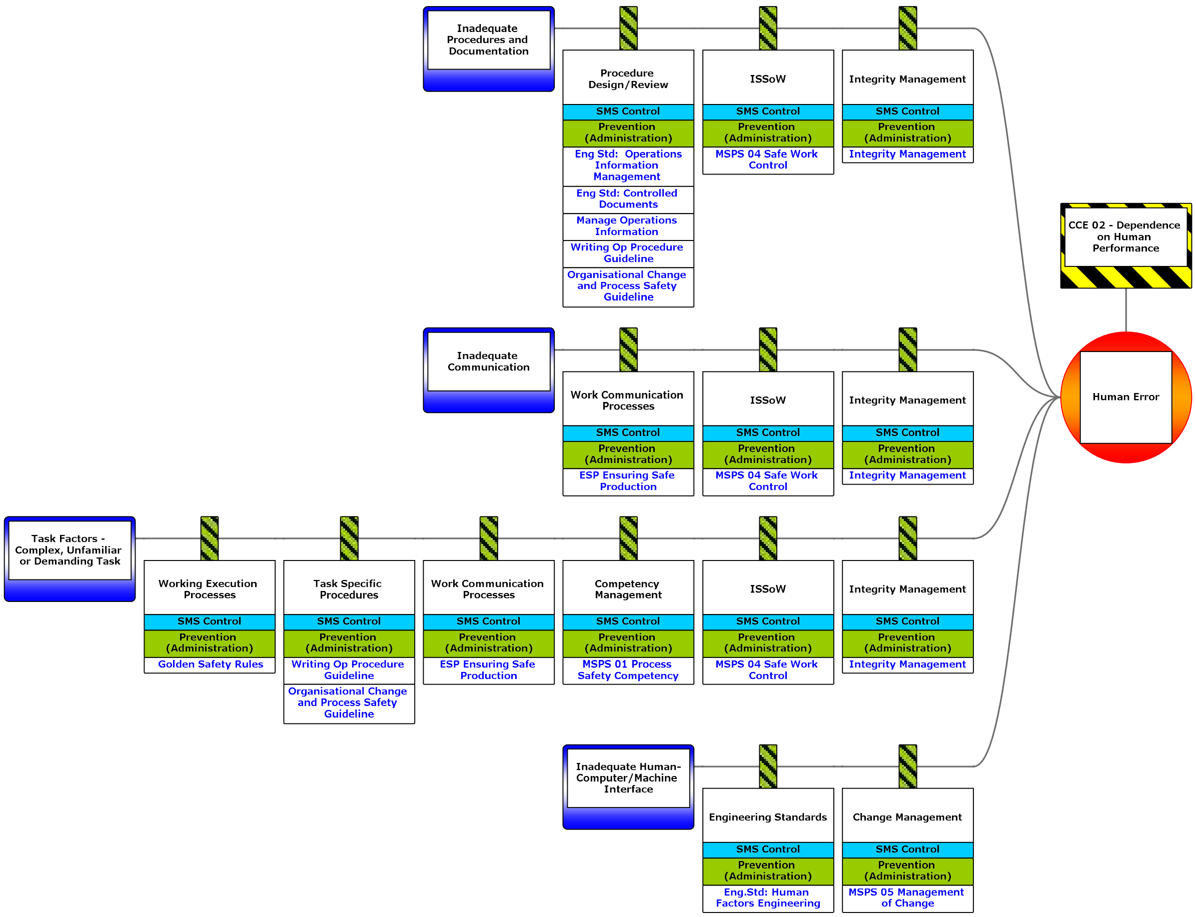

Figure 6-35: Generic Bowtie – Human Error (Causes 1–4)

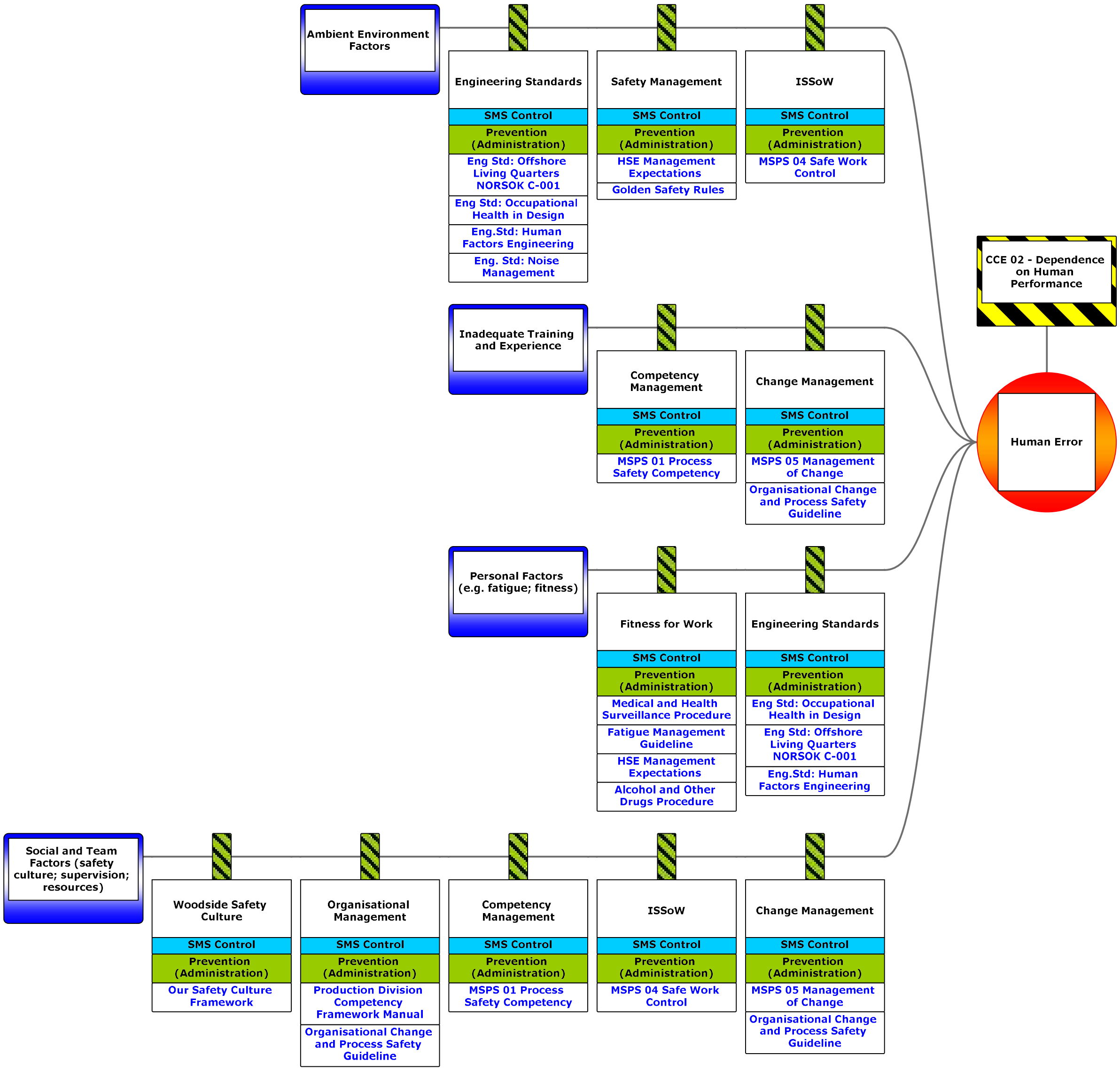

Figure 6-36: Generic Bowtie – Human Error (Causes 5–8)

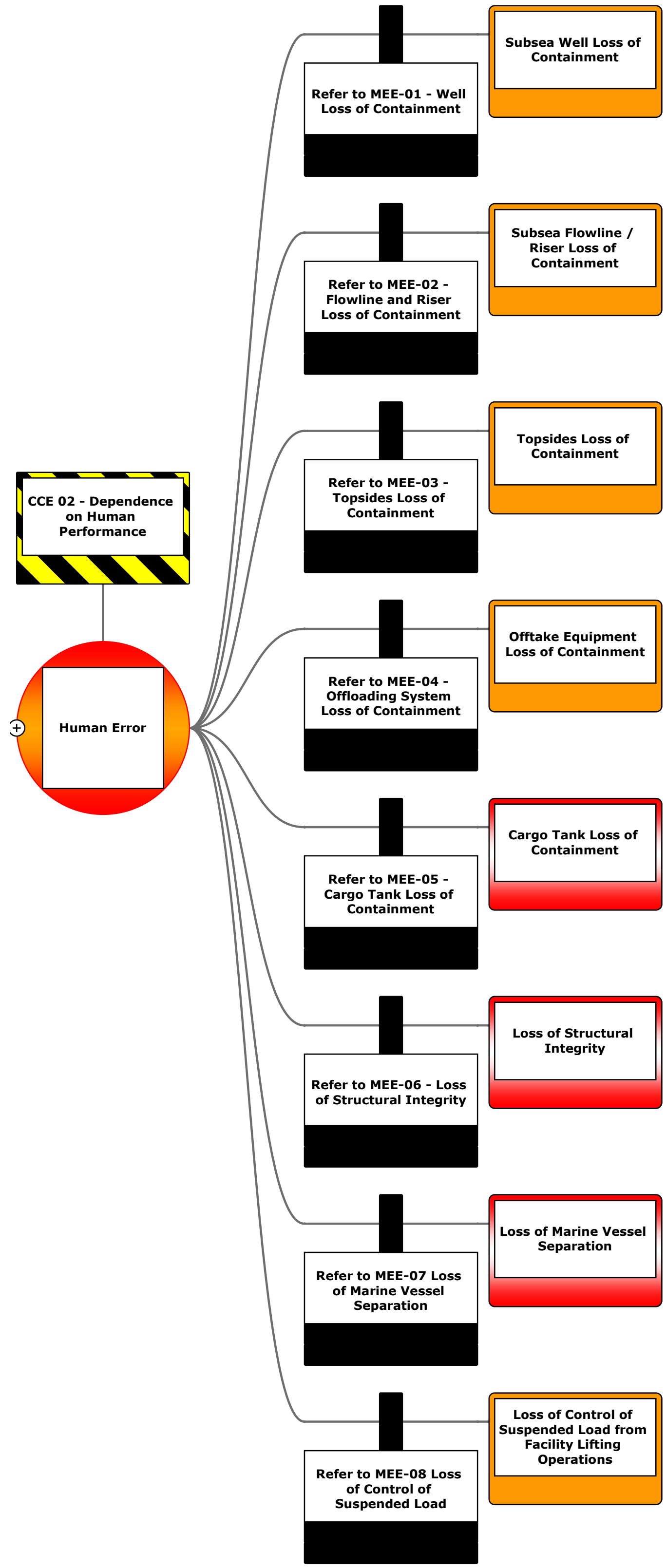

Figure 6-37: Generic Bowtie – Human Error (Outcomes)

7. IMPLEMENTATION STRATEGY

Regulation 14 of the Environment Regulations requires an EP to contain an implementation strategy for the activity. The implementation strategy for the Petroleum Activities Program confirms fit-for-purpose systems, practices and procedures are in place to direct, review and manage the activities so that environmental risks and impacts are continually being reduced to ALARP and are acceptable, and that EPOs and EPSs outlined in this EP are achieved.

Woodside, as Operator, is responsible for ensuring that the Petroleum Activities Program is managed in accordance with this implementation strategy and the WMS (see Section 1.9).

7.1 Systems, Practice and Procedures

All operational activities are planned and carried out in accordance with relevant legislation and internal environment standards and procedures identified in this EP (Section 6).

Processes are implemented to verify controls to manage environmental impacts and risks to:

- a level that is ALARP and acceptable
- meet EPOs
- comply with EPSs defined in this EP.

The systems, practices and procedures that will be implemented are listed in the EPSs contained in this EP. Document names and reference numbers may be subject to change during the statutory duration of this EP; this is managed through a change register and management of change process (Section 7.1.3). Further information regarding some of the key systems, practices and procedures relevant to implementation of this EP is provided below.

7.1.1 WMS Operate Processes

Under the WMS Operate Activity (see Section 1.9 for an overview of the WMS), there are four overarching processes; those directly relevant to the implementation of this EP and environmental management during the Petroleum Activities Program are described below (Operate Plant Process and the Maintain Assets Process).

7.1.1.1 Operate Plant

The objective of the Operate Plant Process is to ensure production is carried out in a safe, efficient, reliable and economic manner, and that all required process variables are within allowable limits. This ensures the potential for unplanned (accident/incident) events that may impact the environment are minimised.

The Operate Plant Process develops key activities to support ongoing production activities in order to ensure the facility is operated within the Basis of Design. The process also identifies required production routines, routine execution, recording of data gathered and formulation of remedial activities. The Operate Plant Process includes the Integrated Safe System of Work (ISSoW) system (described below).

In addition, the Operating Practice MSPS (M02) is in place to assure operating practices are in place, such that:

- integrity-critical operating procedures are available, accurate, up to date, understood and used
- safe operating and technical integrity limits are defined, understood and the process is managed within these limits.

Integrated Safe System of Work

The ISSoW Procedure outlines the key activities required to achieve effective management of permit-controlled work on the facility. The ISSoW process is a management system for all work and is a key element in ensuring the safety of personnel, protection of the environment and technical integrity of the facility.

Work within the facility 500 m PSZ and operations within the vicinity of the connected flowlines is controlled in accordance with ISSoW.

The ISSoW system takes a risk-based approach to activities, thus tasks with higher levels of risk are subjected to greater scrutiny and control. The ISSoW system also allows for low risk routine tasks to be carried out with adequate but minimal administration. The prime objective of ISSoW is to ensure work other than normal operations is properly planned, risk assessed, controlled, coordinated and safely executed. It provides a methodical approach to identifying hazards, assessing risks, and creating and supporting permits to work and associated certificates.

In keeping with ALARP principles, this system is critical to ensuring the appropriate level of hazard identification and risk assessment is carried out for activities performed on the facility.

In addition, the Safe Work Control MSPS (M04) is in place to assure effective safe work control, permit to work and task risk management arrangements are in place and followed to control the risks arising from work activities.

7.1.1.2 Maintain Assets

The Maintain Assets Process aims to improve the reliability and availability of plant and equipment (which includes that required for safe operation) through well managed and planned execution of maintenance that promotes a proactive maintenance culture.

Maintenance, inspection and testing systems and procedures are in place to safeguard the integrity of the facility. The maintenance strategy for the facility is based on optimising safety, minimising environmental impact and maximising production. Maintenance practices used to establish well managed maintenances strategies, planned execution and improvement are described in the Maintenance of Assets Procedure.

A risk-based approach is used as the basis for establishing and prioritising inspection, maintenance and testing requirements at the facility. Equipment is assessed to establish equipment criticality with respect to the consequences and likelihood of equipment failure. This informs determination of appropriate maintenance and inspection activities. Maintenance activities are allocated risk rankings according to the criticality of equipment, to ensure high risk maintenance work orders are completed as a priority.

A computerised maintenance management system (CMMS) provides a database called SAP-PM that contains facility registers, equipment details, spare parts data and associated planned maintenance tasks. This system is used to plan, monitor and record maintenance activities. The system provides a variety of reports that enable monitoring and assessment of maintenance activities.

SCE Technical Performance Standards identify SCEs and associated assurance activities. These activities are identified in the CMMS and given the appropriate priority (Technical Integrity status). Refer to Sections 2.7.5 and 7.1.5 for more detail on SCE Technical Performance Standards and how they differ from EPSs required by the Environment Regulations. SCE Technical Performance Standards form a key component in the processes and systems implemented by Woodside to maintain safety and environment critical plant and equipment.

In addition, the Maintenance and Inspection MSPS (M03) is in place to assure that the necessary inspection and maintenance requirements are identified and carried out to maintain the integrity of SCEs and SCQs.

7.1.2 Process Safety Management

To ensure that Woodside protects the safety, security and health of its employees, contractors, the environment and assets, Woodside has adopted the Energy Institute's Process Safety Management (PSM) framework within its Process Safety Management Procedure which sets out a disciplined framework for managing the integrity of systems and processes that handle hazardous substances over the production (and exploration) lifecycle. It deals with the prevention and control of events that have potential to release hazardous materials and energy.

PSM consists of four main focus areas. Each focus area contains a number of PSM requirements that define key aspects required to ensure that PSM is integrated through the organisation. There are twenty PSM requirements. The focus areas and requirements are shown in Figure 7-1.

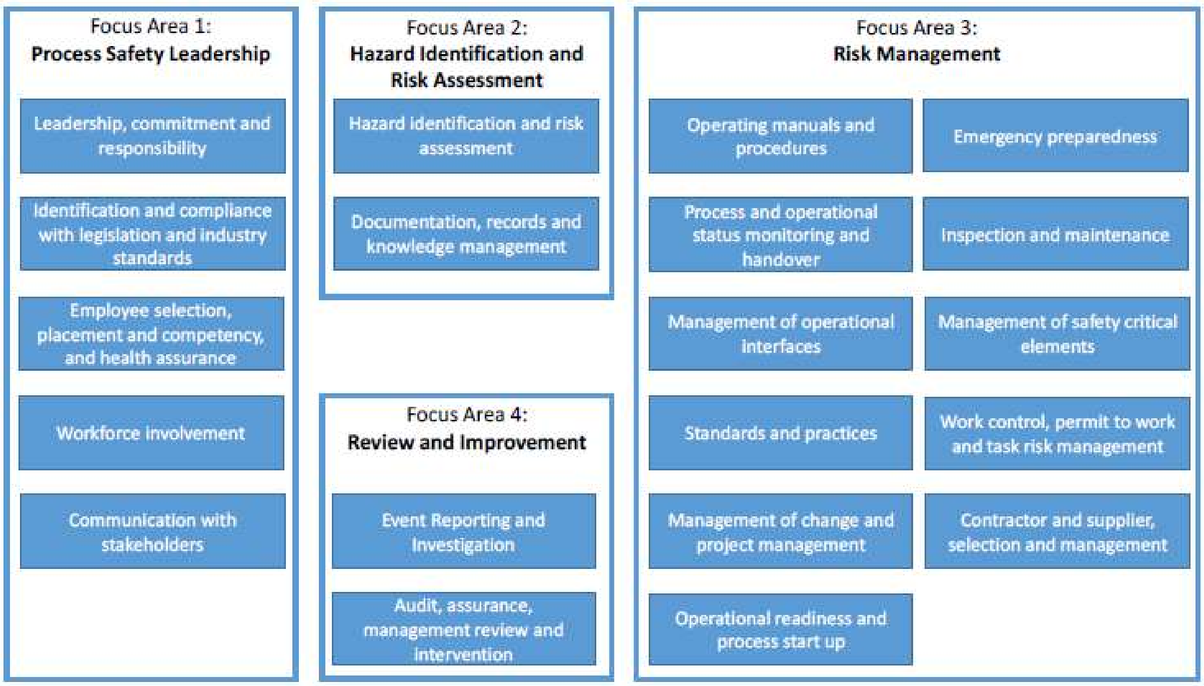

Figure 7-1: Process safety management focus areas

7.1.2.1 Woodside Safety Culture Framework

Woodside's 'Our Safety Culture' framework (shown in Figure 7-2) promotes a strong HSE culture and is a key enabler for effective process safety management. This framework outlines the expected behaviours for everyone including supervisors and managers/executives, and is openly discussed as part of inductions, training and development.

Theme	Everyone	Supervisors	Managers/Executives
Standards	Follow rules	Ensure compliance	Set high standards
Communication	Speak up	Encourage the team	Communicate openly
Risk management	Be mindful	Promote risk awareness	Confront risk
Involvement	Get involved	Involve the team	Involve the workforce

Figure 7-2: Woodside 'Our Safety Culture' framework

7.1.3 Risk Management

Risk management processes and practices are applied on an ongoing basis to design, production and maintenance activities at the Okha facility to manage risks to personnel, assets and the environment.

Potential environmental consequences and impacts from the Okha facility are risk assessed and controlled in accordance with the Woodside risk management processes described in Section 2.2 of this EP (Environmental Risk Management Methodology).

The results of the Okha facility ENVID are described in Section 6 and in the facility Environmental Impacts and Risk Register. This register, in conjunction with the EP, provides a demonstration that environmental risks have been identified, and that appropriate controls are in place to manage those risks to a level that is acceptable and ALARP throughout the life of the facility.

A number of other risk management tools and techniques are used by the Okha facility to manage environmental and other risks on a routine basis during operational, maintenance and inspection tasks. Examples include:

- the processes outlined in Section 0
- risk management tools including: ISSoW tools, e.g. Hazard Identification and Risk Assessments and Level 2 Risk Assessments, Operational Risk Assessments, the technical Management of Change (MoC) system (Section 7.1.4), and Step back 5 x 5
- integrity review studies, HAZIDs and Hazard Operability studies.

These tools, risk and integrity management practices are described further in the Okha Facility Safety Case, WOMP, and the Control of Operational Risk Procedure.

In addition, other risk sub-processes and practices are also applied within Woodside on an ongoing basis to manage different types of risk. A summary of those relevant to the Petroleum Activities Program is provided below. Woodside's risk management processes (refer to Section 2.2.1), along with the supporting risk sub-processes and practices discussed in this section, ensure the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP.

7.1.3.1 Management of Risks – Contracting and Procurement

Suppliers and contractors play a significant role in meeting the resource needs of Woodside's operations, including the facility operations. Effective management of environmental risks in contracts is achieved by setting clear expectations and managing environmental risks throughout the duration of the contract. Environmental risks in contracts are managed under the Contracting and Procurement Procedure supported by the Health, Safety and Environment in Contracting Guideline. The guideline provides a risk-based approach to contractor selection and management, and is aligned with 'HSE Management – Guidelines for Working Together in a Contract Environment' International Association of Oil and Gas Producers, Report No. 423.

The Engineering Standard Quality Requirements for Supply of Products and Services defines specific quality requirements for engineering contracts and purchase orders. The specified quality control requirements in the Standard are required to be complied with as applicable to the scope of supply.

7.1.3.2 Management of Risks – Subsea Activities

Subsea activities are managed in line with the Subsea and Pipelines Integrity Management Procedure which defines the practices and technical requirements that must be applied to deliver and safeguard integrity of the subsea equipment and pipelines during the facility lifecycle. It provides the relationship between the PSM Framework (including management of change) and Subsea and Pipelines Group services processes.

IMMR activities are managed under the Mange IMMR Work Procedure. Risk assessments are conducted as required under this procedure.

These requirements are supported by implementation of the Subsea Construction and Inspection, Maintenance and Repair Environment Screening Questionnaire tool. The screening questionnaire is used to understand the scope of the activity, potential environmental impact and if additional regulatory approvals are required. To achieve this, the questionnaire captures key project information such as seabed disturbance, chemical usage and waste. This information is used by an environment focal point to determine if further assessment is required. For projects that have the potential for environmental impact, an assessment is undertaken against this EP and other Woodside environmental requirements. If determined by the Subsea and Pipeline Environment Screening Questionnaire process, an EP MoC review (as per Section 7.1.4) may be undertaken to confirm if the level of environmental risk warrants revision and resubmission of an EP. Environmental questionnaires are maintained in the Subsea and Pipeline (SSPL) Environment Project Register.

Key environmental requirements and regulatory commitments are communicated to project teams and incorporated into key project documentation where applicable and required (i.e. not addressed via existing Woodside practices).

7.1.3.3 Management of Risks – Major Projects

Major projects are required to follow the Appraise and Develop Management Procedure and the Opportunity Management Framework. This procedure defines the requirements to deliver a commercially valuable production facility or modify to an existing facility. The process workflow requires integration of work from various functions utilising their people and processes, including Environment, for example HSE philosophy and regulatory approval requirements.

These requirements are supported by implementation of the Brownfields Environment Screening Questionnaire tool. The screening tool is used to determine if a project has the potential for environmental impact or requires additional regulatory approvals. For projects that have the potential for environmental impact, an environmental focal point is assigned and the risks and impacts assessed against the facility EP and other Woodside environmental requirements.

Key environmental requirements and regulatory commitments are communicated to project teams and incorporated into key project documentation where applicable and required (i.e. not addressed via existing Woodside practices).Where it is identified that the project scope has the potential to result in significant modification or change to the facility description provided in the EP, or where potential significant new environmental risks or impacts or significant increases in an existing environmental risk or impact are identified, an EP MoC review (as per Section 7.1.4) may be undertaken to confirm if the level of environmental risk warrants revision and resubmission of an EP.

7.1.3.4 Management of Risks – Well Integrity

Wells are managed throughout their lifecycle in line with the Well Lifecycle Management Procedure. This procedure provides the basis for ensuring well integrity in accordance with the Process Safety Management Procedure.

In addition, wells are required to have a regulator-accepted Well Operations Management Plan to demonstrate that well integrity risks are managed to ALARP levels. Wells tied back to the facility are managed under a WOMP.

Management of operating wells can be formally transferred from Operations to the Drilling and Completions (D&C) Function for activities such as well intervention and workover. Where activities are undertaken by the D&C Function, the risks are managed under the D&C Risk Management Procedure, which specifically addresses the risk of loss of containment from a well or well related equipment. This procedure supplements the Woodside Risk Management Procedure.

7.1.3.5 Management of Risks – Marine Services

Woodside's Marine Services Function provides a platform for the conduct of safe and efficient Marine Operations across Woodside through the Marine Services Management. A set of procedures that support vessel assurance and management (including HSE and quality [HSEQ] management) are in place to ensure marine operations are conducted in a safe and efficient manner, and in accordance with regulatory requirements. Management of subsea activities on subsea support vessels is managed by the SSPL Function.

More details on vessel assurance and the communication of environment requirements to vessels are provided in Section 6.8.9.

Vessel masters are required to request clearance from the facility Offshore Installation Manager (OIM) or delegate prior to entering the 500 m PSZ.

7.1.3.6 Management of Human Factor Related Risks

The term 'human factors' is used to describe the consideration of people as part of complex systems. Woodside defines 'human factors' as follows: 'human factors uses what we know about people, organisation and work design to influence performance.

As outlined in Section 6.8.9, human factors can contribute to MEEs, or result in failure or degradation of the controls in place to protect against MEEs. The WMS includes a number of procedures designed to manage human factors related risks and prevent incident causation.

7.1.4 Change Management

Woodside's Change Management Procedure describes Woodside's requirements for change management at Woodside owned or controlled operations/sites.

Change management is used where there is no existing approved business baseline, such as a process, procedure or accepted practice, or where conformance with an approved baseline is not possible or intended; for example, due to equipment fault or failure or a recently discovered issue which will take time to rectify. Change management is also used when the baseline is changed (e.g.

the process is modified). It applies to management of temporary, permanent, planned or unplanned change encompassing one or more of the following:

- plant (equipment, plant, technology, facilities, operations or materials)
- projects (budget, schedule)
- people (organisation structure, performance, roles)
- process (WMS content, processes, procedures, standards, legislation, information).

Woodside's change management process hierarchy is depicted in Figure 7-3. The hierarchy has been developed with sub-processes to address the different types of change performed at Woodside.

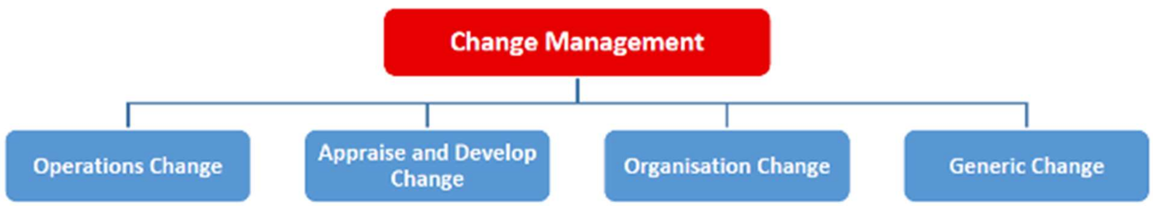

Figure 7-3: Change management hierarchy

To help manage the day to day operation of the facility, Woodside has developed a Golden Safety Rules Booklet, which provides a summary of mandatory requirements for safety in the workplace and includes guidance for managing changes that have a Health, Safety, Integrity and/or Environment impact.

7.1.4.1 Technical Change Management

Technical changes within the Operations Division are managed using the Management of Change – Assets Procedure. The objective of the Management of Change – Assets Procedure is to ensure HSE risks associated with both realised and potential changes, including any failure to meet the facility SCE Technical Performance Standards, are identified, assessed and reduced to ALARP (Section 7.1.5 provides further information on management of SCE Technical Performance Standards).

Assessed changes must be recommended, agreed and decided upon based on the assessed current level of risk, as defined by Woodside's Technical Decision Authority matrices.

The management of change requirements contained in the Process Safety Management Procedure and Management System Performance Standard M05 Management of Change are considered when conducting any changes with the potential to impact process safety.

The Engineering Management Procedure specifies key requirements of engineering related changes, and requires that engineering Technical Decisions are agreed, recommended and decided at the appropriate engineering authority level according to the risk. Change management and risk assessment include consideration of applicable legislation/regulation.

Change is also managed under management system requirements set out as part of major projects (Brownfields), wells integrity, subsea and pipelines integrity management and marine management system. Change management includes consideration of regulatory requirements, managed in accordance with the Regulatory Compliance Management Procedure.

In addition, the Management of Change MSPS (M05) is in place to assure process safety risks arising from change (temporary and permanent) are systematically identified, assessed and managed.

7.1.4.2 EP Management of Change and Revision

Woodside's Environmental Approval Requirements Australia Commonwealth Guideline provides guidance on the Environment Regulations that may trigger a revision and resubmission of the EP to NOPSEMA. The document also provides guidance on what may constitute as new source-based or receptor-based impacts and risks, or a significant increase in an existing source of environmental risk (to provide context in determining if EP resubmission is required under Regulations 8 and 17 of the Environment Regulations).

Minor EP changes, where a review of the activity and the environmental risks and impacts of the activity shows the changes do not trigger regulatory requirements to resubmit the EP, will be considered a 'minor revision'.

Changes with potential to influence minor or technical changes to the EP text are tracked in management of change records, project records, or the Production EP Updates Register, and incorporated during internal updates of the EP or the five-yearly revision.

In accordance with the requirements of Regulation 19 of the Environment Regulations, Woodside will also submit to NOPSEMA a proposed revision to this EP at least 14-days before the end of each period of five years, commencing on the day on which the original and subsequent revisions of the EP are accepted under Regulation 11 of the Environment Regulations.

7.1.4.3 Change of Titleholder's Nominated Liaison Person

In the event of a change to Woodside's nominated liaison person, or a change to the contact details for the titleholder or the nominated liaison person, Woodside will notify NOPSEMA of the change in writing as soon as practicable.

7.1.5 Management of SCE Technical Performance Standards and Management System Performance Standards

7.1.5.1 Management System Performance Standards (MSPS)

Woodside ensures safety critical management processes function as required through the application of MSPS. MSPS are developed and owned at non-facility specific level (i.e. pan Woodside) and include assurance checks for the key requirements of the applicable management system.

Individual facilities demonstrate conformance against the MSPS through the conduct of reviews. Non-conformances against an MSPS are internally managed in accordance with the Woodside Management System.

7.1.5.2 SCE Technical Performance Standards

An SCE is defined by Woodside as a hardware barrier, the failure of which could cause or contribute substantially to, or the purpose of which is to prevent or limit the effect of a MAE/MEE, or Process Safety Event.

Woodside identifies/develops, implements, monitors/assures and verifies/optimises SCEs by applying SCE technical Performance Standards as described in the Safety and Environment Critical Element (SCE) Management Procedure. Key elements of the procedure are summarised in Table 7-1.

Table 7-1: Safety and Environment Critical Element Management Procedure summary

Identify/Develop	**Identify SCE –** SCEs must be identified from the facilities PSRAs (e.g. Formal Safety Assessments) (Section 2.2). The identification of SCEs for which Performance Standards are required are part of the formal safety and environmental risk assessment processes. Woodside's Global Performance Standards (based on industry and Woodside Standards) should be used for preliminary selection of SCEs. **Complete Engineering Design Studies –** Engineering design studies must be completed to demonstrate that SCE Performance Criteria specified in the global Performance Standard and/or determined by PSRA will be met by the facility design, allowing for normal SCE degradation in operation. The studies must establish the testing and inspection tasks required to assess performance against the criteria. The scope and frequency of SCE Assurance Tasks are guided by the Global Performance Standard and may require designated Engineering Design Studies. Studies should include Reliability Centred Maintenance, Risk Based Inspection and Safety Instrumented Function studies to determine the Assurance Task scope and frequencies, RBI plans, and classification and implementation requirements for instrumented safeguarding. **Develop Performance Standards –** Facilities must develop Performance Standards for all SCEs by: • selecting the applicable Global Performance Standard (including Assurance Tasks) • considering facility specific requirements and applicable regulatory requirements • adding the specific data from the facility Engineering Design Studies and PSRA to compile scope and frequency of SCE assurance activities.
Implement	**Identify SCE in Asset Register –** SCEs must be uniquely identified on the asset register and assigned Performance Standard flags. **Develop Testing, Inspection and Maintenance Programs –** SCE assurance tasks are developed into maintenance procedures. **Implement Testing, Inspection and Maintenance Programs –** SCE testing, inspection and maintenance requirements must be implemented in the CMMS (Section 7.1.1.2).
Maintain/Assure	**Execute Testing, Inspection and Maintenance Programs** – On completion of SCE assurance tasks, results must be recorded with all relevant detail, assessed for conformance with the Performance Criteria and any follow on correction work identified. **Conduct Fitness for Service (FFS) Assessment –** In some instances, an engineering FFS assessment may be required to determine whether equipment has failed its performance standard requirements, e.g. assessment of corrosion defects following inspection of piping. Detailed results of FFS assessment may be recorded out of CMMS. **Response to SCE Failure** – SCE failure (technical Performance Standard non-conformance) is a failure to achieve the given Performance Criteria. SCE failures must be managed in accordance with a structured review process. This process may require the application of the facility Manual of Permitted Operation (MOPO) which provides prescriptive guidelines to be followed in the event of a reduction in the performance of an SCE, or managed in accordance with the Management of Change – Assets Procedure (Section 7.1.4). **Internal Reporting** – SCE failure/damage and SCE demands must be reported in accordance with the Health Safety and Environment Event Reporting and Investigation Procedure (Section 7.7.4). **External Reporting** – External notification obligations for SCE failure/damage must be understood (i.e. based on local regulatory requirements). External communications must be in accordance with the health safety and environment event reporting and investigation procedure (Section 7.7.4). **Manage and Analyse Results** – The results from assurance tasks must be accurately recorded to support data analysis. Analysis will enable appropriate action to be taken to minimise future failure recurrences, and enable assessment of overall system performance and reliability to verify SCE effectiveness in revealing failures and to allow predictive maintenance.
Verify/ Optimise	**Review SCE Performance –** SCE performance reviews must be conducted to ensure requirements for maintaining SCE performance are being met. **Manage Change –** Any change to the Performance Standards must be conducted in accordance with the Change Management Procedure (Section 7.1.4).

SCE Technical Performance Standards are a statement of the performance required of an SCE (e.g. functionality, availability, reliability, survivability), which is used as the basis for establishing agreed assurance tasks and managing the hazard. An assurance task is an activity carried out by the operator to confirm that the SCE meets, or will meet, its SCE technical Performance Standard. Examples of assurance tasks include inspection routines, maintenance activities, test routines, instrumentation calibration and reliability monitoring.

These assurance tasks are identified in the CMMS, flagged against their associated technical Performance Standard, and given the appropriate priority (defined as Technical Integrity). Management systems are in place to manage the completion of maintenance including that required for Technical Integrity assurance.

SCE failure (non-conformance) is a failure to achieve a given performance criteria of the SCE technical Performance Standard. SCE failures are managed in accordance to the process defined in the SCE Management Procedure. This process may require the application of the facility Manual of Permitted Operation (MOPO) which provides prescriptive guidelines to be followed in the event of a reduction in the performance of an SCE in specific defined circumstances; or, if the MOPO does not cover the event, according to procedures for the assessment and management of operational risk.

Events related to non-conformances with SCE Technical Performance Standards are classed for internal reporting processes as:

- ‘Failure of SCE’ Event – a failure to meet key requirements or performance criteria stated within the SCE Performance Standard, taking into account any redundancy inherent in the SCE; or
- ‘Damage to SCE’ Event – a failure to meet key requirements or performance criteria stated within the SCE technical Performance Standard (i.e. ‘Failure of SCE’ event), taking into account any redundancy inherent in the SCE, where the increase in potential risk is current and material enough to require an immediate control action to be implemented to maintain risks to an acceptable level.

Both ‘Failure of SCE’ and ‘Damage to SCE’ Events are internally reported as Hazard Events. Where ‘Failure of SCE’ or ‘Damage to SCE’ leads to a loss of hydrocarbon containment, or a release of energy, it is internally reported (and externally where relevant) as a Loss Of Primary Containment or Environmental Spill event, depending on the nature of the release.

Additionally, ‘Damage to SCE’ Events for the SCEs identified in the MEE bowties may equate to a breach of EPOs and/or EPSs. The review to identify ‘Damage to SCE’ Events for external reporting considers whether the hazard event is relevant to environmental key requirements/ performance criteria of the SCE technical Performance Standard and whether the event poses a risk to achieving EPOs and EPSs. External notification reporting requirements for ‘Damage to SCE’ events are outlined within Section 2.7.5.

There may also be planned changes/deviations from SCE Technical Performance Standards, these are managed via procedures for the assessment and management of operational risk, and endorsed in accordance with the engineering management procedures (described further within Section 7.1.4). This management process ensures risks (including environment) are managed so that the planned change/deviation does not result in unacceptable impact or risk, remains ALARP and regulatory requirements are met.

An additional class of SCE exists to capture environment critical emissions monitoring and control equipment and is also managed under this process. The ‘P31 technical Performance Standard – Environmental Emissions Monitoring and Controls’ includes equipment required to comply with environmental legislation, regulations, approval conditions or requirements which apply to the Okha facility. Examples include equipment to monitor flaring emissions. Improvement work is ongoing to optimise management of equipment required for regulatory compliance, where the risk of failure is less than that required to trigger requirement for an SCE technical Performance Standard (i.e. flare metering is not a control for MEEs). This parallel process will facilitate similar management as currently in place for P31 (managed under SCE technical Performance Standards processes) to set out key performance requirements for applicable equipment, maintenance/assurance tasks and to support change management, prioritisation and governance.

7.2 Organisation Structure

The following Woodside organisational structure provides leadership and direction for operation of the Okha facility and environmental performance:

- the Chief Operations Officer (COO) reports to the Chief Executive Officer
- the Senior Vice President (SVP) Australia Operating Unit and Business Unit SVPs or Vice Presidents (VPs) report to the COO
- the General Manager Environment reports to the VP HSEQ
- the Production Environment Manager reports to the General Manager Environment
- the Asset Manager reports to the SVP Australia Operating Unit
- the functional support teams report to the corresponding Business Unit SVP or VP
- all Production facilities are supported by a team of environmental professionals who report to the Production Environment Manager
- all facilities are supported by other Woodside functional teams including:
  - **Engineering** – supports operating assets in terms of engineering standards/guidelines and governance processes, systems, applications and specialist personnel to support these standards/guidelines
  - **HSEQ Support** – provides specific guidance and access to specialist HSEQ resources including assistance for governance and training, as well as guidance on Woodside HSEQ standards
  - **Subsea** – responsible for the installation and IMMR activities on subsea infrastructure including facility structures, flowlines, manifolds and subsea isolation valves to ensure integrity
  - **Drilling and Completions** – ensures the safe planning and execution of drilling (note drilling is excluded from the scope of this EP), completion and work over operations
  - **Brownfields** – responsible for the engineering, construction and execution of small projects on operational facilities to ensure ongoing integrity and safe operation
  - **Marine Group** – responsible for chartering vessels to support Woodside's offshore production facilities including vessels to aid emergency response
  - **Aviation Group** – provides personnel transport, material transport, emergency evacuation and search and rescue capabilities.

A simplified chart of the structural organisation of the Okha facility is shown in Figure 7-4.

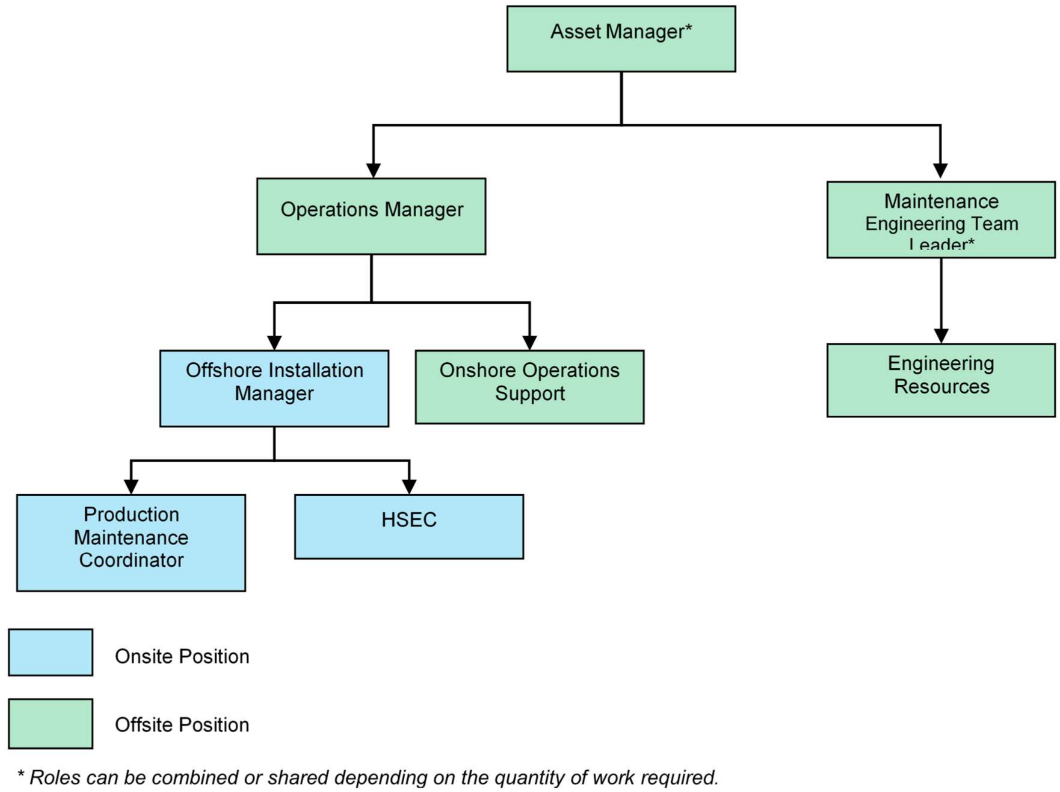

Figure 7-4: Operations Division organisational structure (simplified to show key relevant roles)

7.3 Roles and Responsibilities

As required by Regulation 14(4), this section of the implementation strategy establishes a clear chain of command that sets out the roles and responsibilities of personnel in relation to the implementation, management and review of the EP, ranging from senior management to operational personnel on the Okha FPSO and support vessels.

Key roles and responsibilities for Woodside and Contractor personnel in relation to the implementation, management and review of this EP are described below in Table 7-2. Roles and responsibilities for hydrocarbon spill preparation and response are outlined in Table 7-2 and the Woodside Oil Pollution Emergency Arrangements (Australia) (OPEA (Australia)). Roles and responsibilities for facility emergency response are outlined in the Okha Facility Safety Case and are consistent with the Okha Emergency Response Plan.

It is the responsibility of all Woodside employees and contractors to apply the Woodside Corporate Health, Safety, Environment and Quality Policy (Appendix A) in their areas of responsibility.

Table 7-2: Roles and responsibilities

Title (role)	Responsibilities related to EP
All Personnel	
All facility based personnel and onshore support personnel	• understand the Woodside standards and procedures that apply to their area of work • understand the environmental risks and control measures that apply to their area of work • carry out assigned activities in accordance with approved procedures and the EP • follow instructions from relevant supervisor with respect to environmental protection • cease operations which are deemed to present an unacceptable risk to the environment • participate in environmental assurance activities and inspections as required • prompt reporting of environmental hazards/incidents to their supervisor and assist in event investigation.
Office-based Personnel	
Asset Manager	• accountable for ensuring all necessary regulatory approvals are in place to operate • approves (decides on) the content to be contained in the Environment Plan • accountable for managing the asset throughout its operations in accordance with legislative/regulatory requirements (including this EP) and WMS requirements. Has responsibility for subsea infrastructure from the point of structural disconnection from the Riser Turret Mooring (RTM) • approves written notification to regulatory authorities (for example notifications to NOPSEMA under this Environment Plan) • agrees facility key performance indicators (KPIs), including environment KPIs and is accountable for their achievement • accountable for incident notification, reporting and investigation in line with regulatory requirements, the WMS and EP requirements • decides on technical decisions where required based on assessed current level of risk • responsible for continuous improvement of operations of the facility, including environmental performance • NWS Asset Manager accountable for described petroleum activities occurring within WA-3-L and WA-5-L.
Operations Manager	• responsible for the operation of the facility in accordance with legislative/regulatory requirements (including this EP) and the WMS • accountable for aspects of integrity management • accountable for conformance to production Operations processes including ISSoW • decides on technical decisions where required based on assessed current level of risk • communicates changes relevant to the EP to the Production Environment team.
Maintenance Engineering Team Lead	• responsible for safeguarding process safety with respect to the asset • ensure technical integrity risks are identified, managed and reduced to ALARP • recommends technical decisions where required based on assessed current level of risk

Title (role)	Responsibilities related to EP
Integrity Authorities (Technical Integrity Custodians, Technical Authorities and Engineering Authorities)	• agree technical integrity decision based on assessed current level of risk when discipline owner • undertake process safety responsibilities as defined under the Woodside process safety framework.
Production Environment Manager	• facilitate Production Division environmental approval documentation and timely submission in accordance with regulatory requirements • facilitate review of the EP, including five-yearly revision and in relation to any technical decisions or proposed changes to operations • ensure Production Division understands and adheres to legislative and regulatory environment requirements, EP requirements and the environmental requirements of the WMS • guide and drive environmental management across the Production Division • Monitor and communicate to internal stakeholders all relevant changes to legislation, policies, regulator organisation that may impact the EP or business • develop and maintain appropriate Production environmental processes and procedures • develop (in conjunction with divisional management) environment improvement plans and KPIs • monitor and review progress against environmental improvement plans and KPIs with divisional management to drive continuous improvement • implement effective Production environmental training.
Production Environment Adviser	• ensure Production Division understands legislative and regulatory requirements, EP requirements and WMS environmental requirements • ensure personnel have access to the EP and understand their environmental responsibilities under the EP • manage change relevant to the EP in accordance with the Regulations and the EP • implement environment improvement plans and monitor progress • liaise with applicable regulatory authorities as required • develop, maintain and roll-out environmental training inductions, refreshers and material to promote environmental awareness • ensure environmental monitoring, offshore inspections, and reporting is undertaken as per the requirements of this EP • communicate findings to management • coordinate and monitor closeout of corrective actions • assist with review, investigation and reporting of environmental incidents. • liaise with Woodside contractors and Subsea Support Bessel crew to communicate and ensure their understanding of IMMR related requirements under this EP • conduct IMMR related environment training, messaging/communications, event reporting and investigation as required • ensure environmental inspections/audits are undertaken as per the requirements of the EP

Title (role)	Responsibilities related to EP
	• ensure environmental incident reporting meets regulatory requirements (as described within the EP) and WMS requirements • assurance that all IMMR activities are provided by the EP.
Subsea and Pipelines (IMMR) Activity Manager	• ensure IMMR activities undertaken in line with EP commitments • manage IMMR change requests for the activity and notify the Subsea and Pipelines Environment Adviser of any scope changes in a timely manner • provide sufficient resources to implement the EP requirements • monitor and close out corrective actions raised from IMMR environmental inspections/audits or incidents • responsible for governance of IMMR related activities for Subsea Support Vessels.
Corporate Affairs Adviser	• stakeholder identification and consultation • reporting on stakeholder consultation • ongoing stakeholder liaison as required.
Woodside Marine Services Function	• responsible for pre-charter assurance for all contracted vessels • conduct of ongoing operational assurance of vessels contracted through Woodside Marine, to confirm vessels operate in compliance with relevant legislation, rules and Woodside Marine Charterers Instructions in order to be able to meet safety, navigation, operational and emergency response requirements.
Contractor Sponsors	• ensure implementation of EP for the contractor's scope of work • ensure contractors have adequate environmental capability in order to execute their respective scopes of work • review contractor environmental performance as required.
Offshore-based Personnel	
Offshore Installation Manager	• in charge of the Okha facility and the field to the point of structural disconnection from the RTM • accountable for implementation of the EP at the facility • ensures offshore personnel comply with regulatory/legislative requirements (including the EP) and the WMS • responsible for Area Operations compliance with Technical Integrity requirements including Management of Change process, Permit to Work process and MOPO and process safety requirements • single point responsible person for the coordination of simultaneous activities • accountable for the performance and development of direct reports, ensuring operator capability and competency across all shifts and ensuring the skill requirements of the Production division are being met. • implement relevant offshore environment initiatives and review environmental performance to drive continuous improvement. • ensure effective communication with workforce on environmental performance • ensure incidents are reported and investigated in line with WMS and EP requirements, with appropriate actions initiated and closed out

Title (role)	Responsibilities related to EP
	• lead response efforts (as Incident Controller) in managing emergency or crisis scenarios • ensure exercises and drills are conducted in a manner to assure the facility's ability to respond effectively to an emergency • decides on technical decisions where required based on assessed current level of risk • communicates changes relevant to the EP to the Production Environment team.
Operations Supervisor/Operations Team Leader/Maintenance Team Leader/ Shift Supervisor	• accountable for the day-to-day operations of the facility including effective shift handover; completion and logging of operator routine • responsible for operations shift compliance to all legislative and regulatory requirements as defined in the EP • responsible for permitting and isolation for all frontline work activities • responsible for following emergency response protocols in accordance with the emergency response procedure and fulfilling allocated emergency response roles • responsible for leading and coordinating a multi-disciplined team performing specific duties required to support the facility, including helicopter operations, vessel movements and consumable controls.
Health, Safety and Environment Coordinator (HSEC)	• liaise with managers/supervisors on day to day management of environmental risks and issues • assist in the ongoing promotion of environmental performance at the facilities and day-to-day management HSE risks and issues • support operational personnel to understand the EP requirements applicable to their role • identify opportunities for continuous improvement and communicate these to the OIM and Environment Team • implement environmental improvement plans • communicate environmental performance information and training material to offshore personnel and maintain associated records.
Vessel-based Personnel	
Vessel Master of Facility (from point of structural disconnection from the RTM).	• understand and manage HSE aspects of the vessel, including environmental requirements • communicate with OIM as required regarding potential environmental risks applicable to vessel activities • ensure vessel meets quarantine requirements • notify AMSA and other authorities of any maritime incidents as per maritime requirements • provide, as requested by Woodside, copies of documents, records, reports and certifications (i.e. fuel use, ballast exchanges, waste logs, etc.) in a timely manner to assist in compliance reporting • ensure the vessel's Emergency Response Team have sufficient training to implement the vessel's Ship Oil Pollution Emergency Plan (SOPEP) • ensure all emergency and SOPEP drills are conducted • ensure that vessel procedures are followed in the event of an emergency or spill • immediately notify the Woodside Representative of any environmental incidents.

Title (role)	Responsibilities related to EP
Vessel Master of Support Vessel (Subsea Support Vessels)	• understand and manage HSE aspects of the vessel, including environmental requirements • communicate with OIM as required regarding potential environmental risks applicable to vessel activities • ensure vessel meets quarantine requirements • notify AMSA and other authorities of any incidents as per maritime requirements • provide, as requested by Woodside, copies of documents, records, reports and certifications (i.e. fuel use, ballast exchanges, waste logs, etc.) in a timely manner to assist in compliance reporting • ensure the vessel's Emergency Response Team have sufficient training to implement the vessel's SOPEP • ensure all emergency and SOPEP drills are conducted • ensure that vessel procedures are followed in the event of an emergency or spill • immediately notify the Woodside Representative of any environmental incidents.
Subsea and Pipelines Site Woodside Representative	• ensure relevant management measures in this EP are implemented on the Subsea Support Vessel • ensure periodic environmental inspections are completed • ensure environmental incidents or breaches of EPOs, EPSs or MCs are reported in accordance with Woodside and regulatory requirements • ensure Subsea Support Vessel induction attendance is recorded.

7.4 Training and Competency

As required by Regulation 14(5), this section of the implementation strategy includes measures that ensure all personnel associated with operating the Okha facility are aware of their EP related responsibilities, and that all relevant personnel have appropriate competencies and training.

Environmental training is undertaken to ensure employees and contractors whose work may impact on the environment have the necessary awareness, knowledge and competence appropriate for their role.

Different levels of training are undertaken in relation to managing environmental risks and impacts for the production offshore facilities and associated Subsea Support Vessel based IMMR activities, as follows:

- inductions for offshore facility workers and visitors
- production division competency framework training
- permit to work training (ISSoW)
- production environmental leadership training and environment awareness training
- emergency and hydrocarbon spill response training
- inductions for subsea IMMR (vessel based) personnel.

Records for Woodside production personnel, in relation to the above listed training, are maintained in Woodside's learning management system. Contractor training records are also maintained.

Competence of operations personnel can be reviewed via online dashboards.

7.4.1 Inductions for Offshore Facility Workers and Visitors

A comprehensive induction process is in place for personnel working on or visiting Woodside's offshore production facilities. The induction process is designed to equip personnel with the HSE awareness and skills necessary for them to manage their own safety and environmental performance and contribute to others working around them. The induction process includes:

- **Common Production Induction** – All employees and contractors who have not accessed a production facility within twelve months are required to undertake this induction prior to mobilisation. It includes Woodside's values, HSEQ and Process Safety, continuous improvement, risk management and ISSoW.
- **Facility Specific Induction** – All employees and contractors that have not accessed the production facility within six months are required to undertake this induction on arrival at the facility. This induction covers the HSE and emergency response issues specific to each facility. For environment, this induction covers the Facility EP, prevention of spills, waste management, fauna interactions, hazard identification and risk assessment, and incident reporting.
- **Production Offshore Environmental Leadership Training** – Key operations leadership roles (as specified within the Production Division Competency Framework Manual) are required to complete this competency on commencement of the new role and three yearly thereafter. The training covers Woodside's policies and standards, environmental legislative requirements, the EP, key environmental risk and impacts, environmental reporting, environmental management tools (e.g. improvement planning, compliance reviews and audits), hydrocarbon spill response and environmental accountabilities.

- **Production Offshore Environmental Awareness Training** – All new offshore operational personnel are required to undertake this online training on commencement of the new role and two yearly thereafter. This training covers environmental legislative requirements, the facility EP, key environmental hazards and control measures (including waste management, spill prevention, chemical storage, wildlife interactions), environmental management tools, hazard and incident reporting, spill response, and environmental responsibilities.

7.4.2 Production Division Competency Framework Training

The production division competency framework manual defines a framework to make sure all personnel on operating facilities are competent to perform their work and that competency is managed. By doing this, the potential for unplanned (accident/incident) type events that could result in environmental impact is minimised.

Operational Area Licence to Operate (LTO) roles are those roles related to oil and gas processing, equipment maintenance, marine regulations, emergency response and any other roles involved with safeguarding the facility integrity, including all roles where high-risk work licences are required. Additionally, roles mandated by Woodside such as HSEC and helicopter landing officer are included in the LTO roles process.

The requisite competency and training for each LTO role has been defined. Competencies for these LTO roles are stipulated by the governance group for each respective position and are based on the relevant Australian or International standards which apply. In cases where no Australian or International standards are available or applicable, training is based on the relevant Woodside Standard as determined by the respective governance group.

Contractors working on Woodside facilities are required to verify the competency of their personnel through the contractor's own verification systems. Additionally, contractor personnel working on Woodside facilities are required to be registered in Woodside's Contractor Verification Service (CVS) beforehand. Personnel registered in CVS have had their skills and qualifications independently verified on behalf of Woodside thereby confirming that contractor personnel hold the required competencies before mobilisation to the facility.

The LTO Roles Report (available online on the Woodside Competency Reporting Dashboard on the Production Academy Intranet page) provides the conformance status of the facility against the LTO roles requirements.

7.4.3 Permit to Work System Training

The ISSoW permit to work system (see Section 7.1.1) is a key element in ensuring that all necessary steps are taken to ensure the safety of personnel, protection of the environment and technical integrity of the facility. The ISSoW system takes a risk-based approach to all activities, thus tasks with higher levels of risk are subjected to greater scrutiny and control.

All members of the workforce that are required to work with ISSoW (Section 7.1.1) receive training commensurate with the level of authority and responsibility they hold in ISSoW.

7.4.4 Emergency and Hydrocarbon Spill Response Training

All operations personnel involved in crisis and emergency management are required to commit to ongoing training, process improvement and participation in emergency and crisis response (both real and simulated), including emergency drills specific to potential incidents at the Okha facility. Training includes task specific training and role based training and 'on the job' experience (i.e. participation in crisis or emergency management exercises). Roles based training is further described in Section 7.8.

An overview of Woodside's hydrocarbon spill response training and competency requirements are provided in dashboards for key responder roles. The roles are consistent with Woodside's crisis and emergency management incident control structure.

Woodside Hydrocarbon Spill Preparedness Advisor(s) are responsible for maintaining hydrocarbon spill preparedness competency. This includes the identification and development of approved competency and non-competency based courses, identification of relevant personnel required to undertake training and ensuring training records are maintained. Minimum Woodside capabilities will continue to be identified and documented.

7.4.5 Subsea IMMR Activity Environmental Awareness

At the beginning of, and during a new Subsea IMMR activity, the Subsea Support Vessel crew including contractor crew, Woodside representatives and other relevant personnel are required to undertake a vessel induction before commencing work. This induction covers HSE requirements for the vessel and IMMR activities, and as required environmental information specific to the activity location. The induction may cover the following environmental information:

- adherence to standards and procedures, and the use of Job Safety Analysis and permit to work hazard identification and management process
- spill management including prevention, response and clean-up, location of spill kits and reporting requirements
- waste management requirements and location of bins
- reporting of marine fauna, location of forms and charts
- chemical management requirements.

All personnel who undertake the project induction are required to sign an attendance sheet which is retained.

Regular HSE meetings are held on Subsea Support Vessels with crew. During these meetings, any environmental incidents are reviewed, and environmental awareness material presented.

7.5 Monitoring, Auditing, Management of Non-conformance and Review

Regulation 14(6) states that the implementation strategy is to provide for the monitoring, audit, management of non-conformance and review of operator's environmental performance and the implementation strategy itself.

This Section of the EP outlines the measures undertaken by Woodside to regularly monitor the management of environmental risks and impacts of the Okha facility against the EPOs, EPSs and MCs, with a view to continuous improvement of environmental performance. The effectiveness of the implementation strategy is also reviewed periodically as part of the monitoring and assurance process.

7.5.1 Monitoring

Woodside and its Contractors will undertake a program of periodic monitoring during the Petroleum Activities Program. This information will be collected using the tools and systems outlined below based on the EPOs, controls, EPSs and MCs in this EP. Environmental aspects are integrated into Woodside-wide functional and asset review and assurance processes, which deliver effective governance. This integration of environmental controls into appropriate parent systems and processes includes process safety management (Section 7.1.2), contractor management (Section 7.1.3), marine assurance (Section 7.5.2.4), and energy efficiency optimisation (e.g. Section 3.6.8.6 – Power Generation), and provides multi-faceted assurance of routine implementation.

The tools and systems will collect, as a minimum, the data (evidence) referred to in the MCs in Sections 6.6 and 6.6.8. The collection of this data will form part of the record of compliance maintained by Woodside and will form the basis for demonstrating that the EPOs and EPSs are met. Compliance will be summarised in a series of routine reporting documents (refer to Section 7.7.3).

The following tools and systems to monitor environmental performance, (including collection of evidence of compliance with controls), where relevant, will include:

- environmental emissions/discharge reporting systems that record volumes of planned discharges to ocean and atmosphere, e.g. via the Production Allocation System and process historian database – a summary of emissions and discharges monitoring that will be undertaken during the Petroleum Activities Program is provided within Table 7-3
- monitoring of progress against the Production Function scorecard for KPIs (Section 7.5.4.2)
- routine internal reporting (as described in Section 7.7.2) and routine external annual compliance reporting (as described in Section 7.7.3)
- internal auditing and assurance program (as described in Section 7.5.2).

Collectively, these systems/tools involve collection of evidence of compliance with controls. Throughout the Petroleum Activities Program, Woodside will continue to identify any new source-based risks and impacts through the Monitoring and Auditing systems and tools described above and within Section 7.5.

Other examples of assurance tasks implemented through the EP include (as an example);

- start of shift operator walk arounds
- permit to work hazard, risk management check list, area sign-on, and permit audits (ISSoW – Section 7.4.3)
- technical integrity SCE performance reviews (daily, weekly, monthly) (Section 2.7.5)
- ongoing maintenance performance assurance (e.g. conformance dashboard)
- management system performance audits reviews (e.g. MSPSs) (Section 7.5.2)
- data gathering and governance dashboard presentations (e.g. training conformance).

7.5.1.1 Receptor-Based Knowledge Updates

Under the Woodside Environmental Knowledge Management System regular monitoring to maintain currency of receptor knowledge is carried out as follows:

- Quarterly review of DoEE EPBC Act listed species status, listed species Recovery/Management and Conservation plans is completed and recorded by Environment Science team. The outcome of every monthly review is summarised and issued to the relevant Environment personnel responsible for EP implementation 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 focussed 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.

7.5.1.2 Management of Newly Identified Impacts and Risks

New sources of receptor based impacts and risks identified through monitoring and auditing systems and tools and the Woodside Environment Knowledge Management System will be assessed using the Change Management Process (Section 7.1.4).

Table 7-3: Summary of emissions and discharges monitoring for the Petroleum Activities Program

Category	Parameter to be Monitored/Reported	Monitoring Frequency	Monitoring Equipment/Methodology	EP Reference
Planned Emissions				
Atmospheric Emissions from fuel combustion	Greenhouse, energy and criteria pollutants	Normally continuous process metering/annual reporting	NGERS and NPI reporting estimation methods (e.g. fuel/flare flow meters, throughput meters, process estimation)	Section 6.6.7
	Fuel gas and flare intensity	Normally continuous process metering/monthly reviews	Fuel and flare flowmeters inform intensity profiles – tracked against optimisation targets	Section 6.6.7
Planned Discharges				
Discharge of subsea control fluids during well actuations	Subsea control fluid consumption	Normally continuous process indication/monthly review	Subsea control fluid consumption surveillance. Process indication for gross leaks/ruptures	Section 6.6.4
Discharge of hydrocarbons and chemicals during subsea IMMR activities	Volumes of hydrocarbons and chemicals released subsea	As required, during IMMR activities (activity specific)	Estimates based on known volumes pumped and ROV observation	Section 6.6.4
Discharge of cooling water	Volume of cooling water discharged	Continuously	Flow meter measuring discharged volume	Section 6.6.5
Waste recycling and disposal	Quantities of solid and liquid wastes disposed of onshore	Ongoing	Facility waste manifest	Section 6.7.2
Unplanned Emissions and Discharges				
Unplanned emissions and discharges	Nature of release	As required	HSEQ Event Reporting System (First Priority)	Sections 6.8.2 to 6.8.9

7.5.2 Auditing

7.5.2.1 Operations Assurance

To provide confidence, based on evidence commensurate with risk, that business objectives are met, business activities are performed and risks are managed, assurance is performed as described in the Provide Assurance Procedure and the Provide Assurance Guideline. The Guideline aims to explain how the Operations Division Assurance Team implement WMS Assurance requirements, while concurrently satisfying the Operations Division's specific objectives.

Operations Assurance Assignments are contained within the Operations Division Integrated Assurance Assignment Plan.

Environmental assurance activities are conducted on a regular basis to help:

- verify environmental risks and potential impacts are being managed in accordance with the EPOs and EPSs detailed in this EP
- monitor, review and evaluate the effectiveness of the performance outcomes and standards detailed in this EP
- verify effectiveness of the EP implementation strategy
- identify potential non-conformances.

The outputs of the assurance process are corrective actions that feed the improvement process. Therefore, assurance is a key driver of continuous improvement.

7.5.2.2 Annual Offshore Inspection

An inspection of the Okha facility is undertaken every calendar year by the Production Environment Team. Selected risk areas/activities are inspected to review environmental performance against the EPOs and EPSs and verify that control measures are effective in reducing the environmental risks and impacts of the activity to an ALARP and acceptable level.

The inspection also includes review of conformance with selected aspects of the EP implementation strategy. All risk sources/activities applicable to the offshore facility will be reviewed over a three-year rolling period. Records of findings and close-out of any corrective or improvement actions are maintained (close-out is tracked in Woodside's action tracking system).

7.5.2.3 Subsea Support Vessel Environment Inspection

Environmental inspections of subsea support vessels are undertaken. This involves annual and ongoing inspections of subsea support vessels to ensure that any subsea support vessel is compliant with both the EP and the approved Contractor Management system. Inspections are conducted in line with the SSPL contractor implementation package, however, may include additional requirements for project specific inspection items.

Vessel Inspection findings are captured within a closeout report. Actions arising from subsea support vessel environmental audits are added to the relevant Environmental Commitments and Actions Register (eCAR) within the Subsea Construction, Inspection, Maintenance, Monitoring and Repair Environment Project Register. This eCAR is used to track support vessel compliance with EP commitments, including any findings and corrective actions.

7.5.2.4 Marine Assurance

Marine assurance is undertaken in accordance with Woodside marine assurance procedures which defines the marine assurance activity practices for the different types of vessels either chartered directly by or on behalf of Woodside (including support vessels and offtake tankers). The marine assurance process is managed by the Marine Assurance Team of the Marine Services Group.

The processes and procedures used are based on industry standards and consideration of guidelines and recommendations from recognised industry organisations such as Oil Companies International Marine Forum (OCIMF) and International Maritime Contractors Association.

Support Vessel Assurance

Under the Offshore Vessel Suitability Procedure and the Offshore Vessel Assurance Procedure support vessels (facility and subsea) are subject to a pre-charter vessel suitability and marine assurance process. Intent of the offshore vessel suitability process is to ensure any offshore vessel (i.e. support vessel) is capable of the defined work scope. Intent of the offshore vessel marine assurance process is to ensure all marine contractors and associated suitable vessels are compliant with regard to all legislative and statutory requirements, are well managed and well maintained in addition to meeting any specific requirements held by Woodside.

Under the offshore vessel assurance procedures, regular Woodside, or third-party inspections are usually required for support vessels. Support vessel inspections are not always required and may be replaced by a risk assessment. Woodside uses the OCIMF Offshore Vessel Inspection Database inspection as its primary means for inspecting vessels. These inspections assess compliance with laws of the international shipping industry, including safety management requirements and maritime legislation including International Convention of the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL) and other International Maritime Organisation Standards.

Offtake Vessel Assurance

Prior to gaining Woodside's acceptance for offtake from the Okha FPSO, under tanker assurance procedures and offtake tanker FPSO compatibility procedures, export tankers are subject to a marine assurance process and a vessel compatibility process. Under these procedures, export tankers are assessed for their performance, quality (historic performance or incidents, documentation, systems and procedures) and operational compatibility with the facility. Additional quality assurance of tankers is provided by external bodies with access to extensive databases, which ensures thorough evaluation (for example, the Shell 'GMAS' system). A tanker will only be accepted by Woodside for offtake if it passes the assessment process. This requirement applies to each tanker offload irrespective of the tanker flag, operator, or the date of the last visit to a Woodside terminal. The export tanker assurance process is documented. Tanker assurance records are retained by Woodside.

Once accepted for offtake, the tanker must comply with requirements under the Okha Terminal Handbook, which contains rules, information and operations guidelines. The Handbook also describes the operations and approach to the Okha facility's cautionary and safety zone and the rules that apply in each area. Approach to the facility must first be approved by the Okha OIM and then occurs under supervision of a Woodside Pilot, in accordance with the International Maritime Organization and International Maritime Pilots Association Guidelines.

Environmental requirements specific to offshore facility support vessel contractors are communicated via Woodside marine charterers instructions. This document provides the Master of a vessel on hire to Woodside, with a clearly defined set of requirements and procedures for operating the vessel in the vicinity of the Woodside's operating facilities. This includes the management of environmental risks and impacts from the Okha facility. The document includes information on:

- applicable legislation and guidelines
- roles and responsibilities
- marine fauna interaction guidance

- incident reporting requirements.

Environmental requirements specific to Subsea Support Vessels are communicated via the Subsea Environmental Compliance Package. This document outlines mandatory environmental management requirements for Subsea Support Vessels and associated contractors.

7.5.3 Management of Non-conformance (Internal)

Woodside employees and Contractors are required to internally report all environmental incidents and hazards, including potential non-conformances with EPOs and EPSs in this EP.

The Health, Safety and Environment Event Reporting and Investigation Procedure defines how incidents and hazards are internally reported. Key requirements are set out through the use of an Event Report Form, which includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence. An internal online database called First Priority is used for the recording and reporting of these events. Corrective actions are monitored using First Priority and closed out in a timely manner.

Detailed investigations are completed for all incidents with an actual impact of A, B or C, and high potential environmental incidents and hazards. The classification, reporting, investigation and actioning of environmental incidents and hazards is undertaken in accordance with the Health, Safety and Environment Event Reporting and Investigation Procedure supported by the HSE Event Reporting Guideline. Event bulletins may be used for communication of learnings from significant events.

Non-conformances with EPOs and EPSs are also internally reported and investigated in accordance with Regulatory Compliance Management Procedure, supported by the Regulatory Compliance Management Guideline.

External regulatory reporting requirements for this activity are outlined in Section 7.7 of this EP.

7.5.4 Review

7.5.4.1 Environmental Risk Review

Woodside risk management processes include risk review. Woodside's risk management processes are described in Sections 2.2.1 and 7.1.3 and are applied on a day-to-day basis. The Facility Environmental Impacts and Risk Register must be reviewed and updated every five years.

Monitoring (Section 7.5.1) and assurance (Section 7.5.2) and review (Section 7.5.4) are also used to identify potential new information that may arise during the activity and ensure that performance outcomes and standards are being met and EP environmental control measures are effective. Whilst conducting these activities, qualified, experienced environment advisors, in consultation with experienced Operational and/or Engineering personnel use their professional judgement, to identify potential new control measures that have potential to improve environmental outcomes or reduce risk. As various monitoring/assurance/review processes are used there is not an overarching procedure/checklist that is suitable to contain a prompt for consideration of new environmental controls.

In addition, Woodside's risk management practices and processes are systematically applied on an ongoing basis to activities provided for within the EP (as summarised within Section 7.1.3). Via these processes and practices, new risk controls for individual planned and unplanned events may be selected and implemented (proportional to risk levels). When such risk controls are identified by environmental advisors as being relevant to the overarching EP sources of risk, these may also be added as new EP control measures. Any new or improved EP environmental controls or specific measures (that have the potential to improve environmental outcomes or reduce risk), can be tracked within the production EP updates register for incorporation into the EP at its next revision. The EP may be internally revised to reflect these changes without resubmission.

Where review processes identify new or improved controls relevant to environmental risks identified in this EP (that have the potential to improve environmental outcomes or reduce risk), the EP may be internally revised to reflect these changes without resubmission.

7.5.4.2 KPI Review

Within the Production Division environment, key performance indicators (KPIs) are developed annually and agreed with senior management (i.e. Okha Asset Manager). Progress against the environment KPIs is tracked within Asset Scorecards.

Reviews of hydrocarbon spill arrangements and testing are carried out in accordance with Appendix D.

7.5.4.3 Learning and Knowledge Sharing

Learning and knowledge sharing occurs within the Production Division via a number of different methods, including for example:

- Operations Learnings meetings
- event investigations
- event bulletins
- engineering and technical authorities discipline communications and sharing.

7.5.4.4 Continuous Improvement

Continuous Improvement (CI) Projects to improve production or environmental performance that involve refurbishment, modification or major maintenance on the facility are typically managed by Brownfields Engineering, and required to follow appraise and develop management procedures. Currently, the Procedure requires that all projects be managed in accordance with the Opportunity Management Framework which supports the progressive maturation of an opportunity through value creation in the Assess and Select Phases and the maintenance of value in the Develop and Execute phases.

To support the accountable executive to make a decision on whether a CI Project should proceed to the next phase in the Opportunity Management Framework, it is sometimes necessary to conduct a trial of the modification to determine the outcomes that can be expected if the modification is implemented. Due to prioritisation of resources, the phased progress of opportunities, competition between different solutions and long-term strategic and financial considerations, it is not possible to set quantitative success criteria to determine whether a modification will be implemented based on the results of trials. Instead, the results of a trial are used to inform a decision on whether to progress the CI Project to the next phase in the Opportunity Management Framework. Decisions are typically made with two key considerations; whether the business is ready to proceed which has a technical/functional focus and whether there is a business case for progressing to the next phase. The business case may consider the ALARP position for the CI Project, if relevant.

7.6 Record Keeping

Compliance records (outlined in MCs in Section 6) will be maintained. Record keeping will be in accordance with Regulation 14(7) that addresses maintaining records of emissions and discharges such that the records can be used to assess whether EPOs and EPSs are being met (refer to Section 7.5.1 and Table 7-7 for a summary of records that will retained).

7.7 Reporting

7.7.1 Overview

In order to meet the EPOs and EPSs outlined in this EP, Woodside undertakes reporting at a number of levels. These reporting arrangements are outlined below.

7.7.2 Routine Reporting (Internal)

7.7.2.1 Daily Reports

The following daily reports, containing environmental performance information are issued:

- Pan-Woodside Daily Production Report – The report includes facility performance information on production and a log of any HSE events.
- Subsea support vessel Daily Progress Report(s) – During subsea IMMR activities, daily reports are issued by the Woodside Site Representative. The reports provide performance information on HSE events, diesel use, together with equipment information, current and planned work activities.

7.7.2.2 Performance Reporting

A number of routine performance reports are developed in support of the facility operational activities. These reports cover HSE, production and process safety performance. Information included in these reports, relevant to the EP, includes:

- summary of environment incidents
- current and planned work activities, significant events (e.g. shutdowns, failures)
- integrity status and process safety metrics
- status of subsea IMMR activities.

7.7.3 Routine Reporting (External)

7.7.3.1 Environmental Performance Review and Reporting

In accordance with applicable environmental legislation for the activity, Woodside is required to report information on environmental performance to the appropriate regulator.

Routine regulatory reporting requirements are summarised in Table 7-4. The requirements include that Woodside will develop and submit an annual Environmental Performance Report to NOPSEMA, with the first report submitted within 12 months of the commencement of activities covered by this EP (as per the requirements of Regulation 14(2)(b)) (i.e. by 30 April the following year).

Table 7-4: Routine external reporting requirements

Report	Recipient	Frequency	Content
Monthly Recordable Incident Report	NOPSEMA	Monthly, by 15 of each month	As required by Regulation 26B, details of recordable incidents that have occurred under the EP for the previous month. Refer to Section 7.7.5 for more detail.
Annual Environment Plan Performance Report	NOPSEMA	Annual, by 30 April of the year following reporting period	As required by Regulation 14 (2) and 26C the report will report compliance with the EPOs and EPSs outlined in Section 6 of this EP. The reporting period is 1 January to 31 December each year.

Report	Recipient	Frequency	Content
National Pollutant Inventory (NPI) Report	DoEE	Annual, by 30 September each year	Summary of the emissions to land, air and water including those from the facility. Reporting period 1 July to 30 June each year.
National Greenhouse and Energy Reporting (NGERS)	Clean Energy Regulator	Annual, by 31 October each year	Summary of energy use and greenhouse gas emissions including those from the facility. Reporting period is 1 July to 30 June each year.

7.7.3.2 End of the Petroleum Activities Program Notification

In accordance with Regulation 29, Woodside will notify NOPSEMA[26] within ten days of the completion of the Petroleum Activities Program. The Petroleum Activities Program is not expected to end within the five-year life of this EP.

7.7.3.3 End of the Environment Plan

The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended, all of the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A of the Environment Regulations. As noted above, the Petroleum Activities Program is not expected to end within the five-year life of this EP.

7.7.4 Incident Reporting (Internal)

All Woodside employees and contractors are required to report environmental incidents and non-conformances with this EP. Incidents are reported using an Event Report Form which includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence (for further details refer to Section 7.5.3).

7.7.5 Incident Reporting (External) – Reportable and Recordable

Woodside's regulatory reporting requirements are outlined within the Regulator Event Reporting Procedure supported by the Regulator Event Reporting Guideline.

7.7.5.1 Reportable Incidents

A reportable incident is defined under Regulation 4 of the Environment Regulations as 'an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage'.

A reportable incident for the Petroleum Activities Program is:

- An incident that has caused environmental damage with a Consequence Level of Moderate CAN or above (as defined under Woodside's Risk Table; refer to Section 2.6).
- An incident that has the potential to cause environmental damage with a Consequence Level of Moderate CAN or above (as defined under Woodside's Risk Table – refer to Section 2.6).

The environmental risk assessment (Section 6) for the Petroleum Activities Program identifies those risks with a potential consequence level of C+ for environment. The incidents that have the potential to cause this level of impact include hydrocarbon loss of containment events to ocean resulting from either:

- loss of well containment (MEE-01)
- subsea equipment loss of containment (MEE-02)

[26] NOPSEMA has already been notified of commencement of operations of the facility.

- topsides loss of containment (MEE-03)
- offtake equipment loss of containment (MEE-04)
- loss of structural integrity (MEE-05)
- cargo tank loss of containment (MEE-06)
- loss of marine vessel separation (MEE-07)
- loss of control of suspended load from Okha lifting operations (MEE-08).

Any such incidents represent potential events which would be reportable incidents. Reporting of incidents is undertaken with consideration of NOPSEMA (2014) guidance stating, 'if in doubt, notify NOPSEMA', and assessed on a case-by-case basis to determine if they trigger a reportable incident as defined in this EP and by the regulations.

Notification

NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations. Woodside will:

- orally notify NOPSEMA of all reportable incidents to the regulator as soon as practicable, but within two hours of the incident or of its detection by Woodside
- provide a written record of the reported incident to NOPSEMA, the National Offshore Petroleum Titles Administrator (NOPTA) and the Department of the responsible State Minister (Department of Mines, Industry Regulation and Safety [DMIRS]) as soon as practicable after the oral notification of the incident
- complete a written report for all reportable incidents using a format consistent with the NOPSEMA Form FM0929 – Reportable Environment Incident which must be submitted to NOPSEMA as soon as practicable, but within three days of the incident or of its detection by Woodside
- provide a copy of the written report to NOPTA and DMIRS, within seven days of the written report being provided to NOPSEMA.

7.7.5.2 Recordable Incidents

A recordable incident is defined under Regulation 4 of the Environment Regulations as a 'breach of an EPO or EPS, in the EP that applies to the activity, that is not a reportable incident'.

Any breach of the EPOs or EPSs (as presented within Section 6) will be raised as a recordable incident and managed as per the notification and reporting requirements outlined below and internal requirements outlined in Section 7.7.

Additional performance standards and management measures are included within Section 7.9 of the implementation strategy and within stakeholder consultation (Section 6). Any breach of these will not be raised as a recordable incident (as defined within the Environment Regulations) but will be managed internally.

Notification

NOPSEMA will be notified of all recordable incidents, according to the requirements of Regulation 26B (4). Woodside will:

- provide a written record not later than 15 days after the end of the calendar month using a format consistent with the NOPSEMA Form – Recordable Environmental Incident Monthly Summary Report (Appendix E).

7.7.5.3 Other External Reporting Requirements and Notifications

In addition to the notification and reporting of environmental incidents defined under the Environment Regulations and Woodside requirements, the following incident reporting requirements also apply in the Operational Area if the spill originates from a vessel:

- Any oil pollution incidents in Commonwealth Waters will be reported (by the vessel master) to AMSA Rescue Coordination Centre (RCC) as per Article 8 and Protocol I of MARPOL within two hours via the national emergency 24-hour notification contacts, and a written report within 24-hours of the request by AMSA. (This requirement is included in the Okha Oil Pollution First Strike Plan; Appendix H).

  If the ship is at sea, reports are to be made to:

  Free call: 1800 641 792

  Phone: 08 9430 2100 (Fremantle).

- Any spills greater than ten tonnes in Commonwealth Waters must be reported (by the vessel master) to AMSA within one hour. (This requirement is detailed in the Okha Oil Pollution First Strike Plan; Appendix H). Reports are to be made via the national 24-hour emergency notification contacts (AusSAR: RCC):

  Rescue Coordination Centre Australia (RCC Australia)

  Phone: 02 6230 6811

  Facsimile: 02 6230 6868

  Telex: 62349

  Free call: 1800 641 792

  AFTN: YSARYCYX.

- A hydrocarbon spill incident with potential to significantly impact MNES must be reported to DoEE.
- If the activity described within this EP results in the unintentional death of or injury to a fauna that constitute MNES (i.e. species listed as Threatened or Migratory under the EPBC Act), and the activity was not authorised by a permit, the Secretary of the DoEE should be notified within seven days of becoming aware of the results of the activity:

  The Secretary

  DoEE

  Hotline: 1800 803 772

  Email: protected.species@environment.gov.au.

For hydrocarbon spill incidents, other agencies and organisations[27] will be notified as appropriate to the nature and scale of the incident as per procedures and contact lists in the Oil Pollution Emergency Arrangements (Australia) and the Okha Oil Pollution First Strike Plan (Appendix H), including but not limited to:

- A hydrocarbon spill incident with the potential to significantly impact MNES must be reported to DoEE.

[27] The Director of National Parks will be notified if Woodside becomes aware of a hydrocarbon spill occurring within, or potentially impacting upon the values of, a Commonwealth Marine Park.

- A hydrocarbon spill incident occurring within a marine park, or with the potential to impact a marine park must be reported to DNP as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer on 0419 293 465. The notification should include:
  - titleholder details
  - time and location of the incident (including name of marine park likely to be affected)
  - proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.)
  - confirmation of providing access to relevant monitoring and evaluation reports when available
  - contact details for the response coordinator.

DNP notification to marineparks@environment.gov.au is required:

- When the EP is approved by NOPSEMA.
- Notification at least 10-days prior to all inspection, monitoring (including scientific monitoring), maintenance or repair activities occurring within the Montebello AMP (excluding transiting) and conclusion of that activity.
- In cases where inspections are required for emergent issues or following a cyclone, notifications will be provided as soon as practicable. Notification information should be consistent with the Petroleum activities and AMP guidance note.

7.8 Emergency Preparedness and Response

7.8.1 Overview

Under Regulation 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 7-5.

Table 7-5: Oil pollution preparedness and response overview

Content	Environment Regulations Reference	Document/Section Reference
Details (oil pollution response) control measures that will be used to reduce the impacts and risks of the activity to ALARP and an acceptable level	Regulation 13 (5), (6), 14 (3)	Oil Spill Preparedness and Response Mitigation Assessment (Appendix D).
Describes the oil pollution emergency plan	Regulation 14 (8)	Environment Plan: Section 7.8. Woodside's oil pollution emergency plan has the following components: • Oil Pollution Emergency Arrangements (Australia) • Okha Oil Pollution First Strike Plan (Appendix H) • Oil Spill Preparedness and Response Mitigation Assessment (Appendix D).
Details the arrangements for responding to and monitoring oil pollution (to inform response activities), including control measures	Regulation 14 (8AA)	Oil Spill Preparedness and Response Mitigation Assessment (Appendix D). Okha Oil Pollution First Strike Plan (Appendix H).

Content	Environment Regulations Reference	Document/Section Reference
Details the arrangements for updating and testing the oil pollution response arrangements	Regulation 14 (8), (8A), (8B), (8C)	Environment Plan: Section 7.8.6. Oil Spill Preparedness and Response Mitigation Assessment (Appendix D).
Details provisions for monitoring impacts to the environment from oil pollution and response activities	Regulation 14 (8D)	Oil Spill Preparedness and Response Mitigation Assessment (Appendix D).
Demonstrates that the oil pollution response arrangements are consistent with the national system for oil pollution preparedness and control	Regulation 14 (8E)	Oil Pollution Emergency Arrangements (Australia).

7.8.2 Emergency Response Training

Regulation 14(5) requires that the implementation strategy includes measures to ensure that employees and contractors have the appropriate competencies and training. Woodside has conducted a risk based training needs analysis on positions required for effective oil spill response. Following the mapping of training to Woodside identified competencies, training was then mapped to positions based on their required competencies (Table 7-6).

Table 7-6: Minimum levels of competency for key IMT positions.

IMT Position	Competency
Incident Commander, Operations, Planning, Logistics, Safety	• Coordinate Incident Response (PMAOIR418/IMO3) (Incident Commander Only) • Participation in L2 oil spill exercise (initial) • Participation in L2 oil spill exercise (refresher) • Oil Spill Response Skills Enhancement Course (OSREC – internal course)

7.8.3 Emergency Response Preparation

The Corporate Incident Communication Centre (CICC), based in Woodside's head office in Perth, is the onshore coordination point for an offshore emergency. The CICC is staffed by an appropriately skilled team available on call 24-hours a day. The purpose of the team is to coordinate incidents maintain the safety of personnel, minimise damage to the environment and facilities, and to liaise with external agencies. A description of Woodside's Incident Command Structure and arrangements is further detailed in the Woodside OPEA (Australia). Roles and responsibilities for facility emergency response are outlined in the Okha Safety Case and the Pipelines Safety Case are consistent with the Okha Emergency Response Plan and the Pipelines Emergency Response Plan.

Woodside has a number of Emergency Response Plans (ERP) in place, which detail the actions and resources available in the event of various emergency scenarios. Electronic copies of the ERPs are available on the facility Virtual Bookshelves and the S&EM intranet page. Hard controlled copies are available on the facilities.

In addition, the Emergency Preparedness MSPS (M06) is in place to assure that in the event of an incident, the organisation is appropriately prepared for all necessary actions which may be required for the protection of People, Environment, Asset, Reputation and Livelihood.

7.8.3.1 Initial Response to Facility Incident

The facility is equipped with emergency shutdown systems designed to protect personnel, the facility and the environment from unsafe operating conditions and catastrophic situations.

Emergency shutdown systems are provided as a means of isolation in response to process upsets and facility conditions (including associated flowlines and risers) that could result in loss of hydrocarbon inventories, or to reduce the potential impact from a hydrocarbon loss of containment event on the facility. Provision has been made for process and facility alarm systems to provide early indication of any process upset conditions and potential hazardous events, including fire and gas alarms.

The key ERP relevant to the facility and subsea infrastructure (excluding the export pipeline) is the Okha Emergency Response Plan. This plan covers health, safety, asset and environmental risks (including fire, structural integrity, sabotage, etc.) to ensure the range of occupational, asset and environmental risk exposures from incidents have been considered and plans are in place for their management. The plan provides specific details on the initial response required during events with potential significant environmental consequences such as a hydrocarbon spill, subsea hydrocarbon leak or potential collision.

The Pipelines Emergency Response Plan covers key ERP relevant to the export pipeline, as well as other major pipelines on Woodside's NWS facilities. The Okha Oil Pollution First Strike Plan provides immediate actions required to commence a response (Appendix H). Vessels will have SOPEPs in accordance with the requirements of MARPOL 73/78 Annex I. These plans outline responsibilities, specify procedures and identify resources available in the event of a hydrocarbon or chemical spill from vessel activities. The Okha Oil Pollution First Strike Plan is intended to work in conjunction with the SOPEPs, if hydrocarbons are released to the marine environment from a vessel.

Woodside has established EPOs, EPSs and MCs to be used for hydrocarbon spill response during the Petroleum Activities Program, as detailed in Appendix D.

7.8.4 Oil and Other Hazardous Materials Spill

A significant hydrocarbon spill during the Petroleum Activities Program is unlikely, but should such an event occur, it has the potential to cause serious environmental and reputational damage if not managed properly. The Woodside OPEA (Australia) document, supported by the Okha Oil Pollution First Strike Plan which provides tactical response guidance to the activity/area (Appendix H), and Appendix D of this EP, cover spill response for this Petroleum Activities Program.

The Security and Emergency Management Function is responsible for the management of Woodside's hydrocarbon spill response equipment and for the maintenance of hydrocarbon spill preparedness and response documentation. In the event of a major spill, Woodside will request that AMSA (administrator of the National Plan) provides support to Woodside through advice and access to equipment, people and liaison. The interface and responsibilities, as defined under the National Plan, are described in the OPEA (Australia). AMSA and Woodside have a Memorandum of Understanding in place to support Woodside in the event of a hydrocarbon spill.

7.8.5 Emergency and Spill Response

Woodside categorises incidents in relation to response requirements as follows:

- **Level 1 Incident** – A Level 1 incident can be resolved through the use of existing resources, equipment and personnel. A Level 1 incident is contained, controlled and resolved by site / regionally based teams using existing resources and functional support services.
- **Level 2 Incident** – A Level 2 incident is characterised by a response that requires external operational support to manage the incident. It is triggered in the event the capabilities of the tactical level response are exceeded. This support is provided to the activity via the activation of all, or part of, the responsible ICC.
- **Level 3 Incident** – A Level 3 incident or crisis is identified as a critical event that seriously threatens the organisation's People, the Environment, company Assets, Reputation, or Livelihood. At Woodside, the Crisis Management Team (CMT) manages the strategic impacts in

order to respond to and recover from the threat to the company (material impacts, litigation, legal and commercial, reputation etc.). The ICC may also be activated as required to manage the operational incident response requirements.

7.8.6 Emergency and Spill Response Drills and Exercises

Testing of Woodside's capability to respond to incidents will be conducted in alignment with the Emergency and Crisis Management Procedure. The scope, frequency and objective of these tests is described in Table 7-7. Woodside's emergency response testing regime is aligned to existing or developing risks associated with Woodside's operations and activities. Corporate hazards/risks outlined in the corporate risk register, respective Safety Cases or project Risk Registers, are a reference point for emergency management and crisis management exercising schedule development. External participants may be invited to attend exercises such as government agencies, specialist service providers, oil spill response organisations or industry members with which we have mutual aid arrangements.

The overall objective of exercising is to test procedures, skills and teamwork of the Emergency Response and Command Teams in their ability to respond to MAEs and MEEs. After each exercise, the team holds a debrief session, during which the exercise is reviewed. Any lessons learnt or areas for improvement are identified and incorporated into revised procedures where appropriate.

Table 7-7: Testing of response capability

Response Category	Scope	Response Testing Frequency	Response Testing Objective
Level 1 Response	Exercises are asset specific	Two comprehensive Level 1 'First Strike' drills conducted per year, per asset. Additional Level 1 emergency drills routinely conducted (approximately one per fortnight).	• Comprehensive exercises test elements of the Okha Oil Pollution First Strike Plan for a Level 1 incident (Appendix H). • Emergency drills are scheduled by each asset to test other aspects of their Emergency Response Plan.
Level 2 Response	Exercises are relevant to all Woodside assets	A minimum of one Emergency Management exercise will be conducted biennially.	• Testing both the facility IMT response and/or that of the CICC following handover of incident control.
Level 3 Response		The number of CMT exercises conducted each year is determined by the Chief Executive Officer, in consultation with the Vice President of Security and Emergency Management.	• Test the ability of the company to respond to and manage a crisis level incident.

7.8.7 Hydrocarbon Spill Response testing of Arrangements

Woodside is required to test hydrocarbon spill response arrangements as per regulations 8B and 8C in the Environment Regulations. Woodside's arrangements for spill response are common across Australian operating assets and activities to ensure controls are consistent. The overall objective of testing these arrangements is to ensure that Woodside maintains an ability to respond to a hydrocarbon spill, specifically to:

- ensure relevant responders, contractors and key personnel understand and practise their assigned roles and responsibilities
- test response arrangements and actions to validate response plans

- ensure lessons learned are incorporated into Woodside processes and procedures and improvements made where required.

In the event that new response arrangements are introduced, or existing arrangements significantly amended, additional testing is undertaken accordingly. Should the Okha FPSO leave the field for an extended period, additional testing will be undertaken when the facility returns to routine operations. Additional activities or activity locations are not anticipated to occur; however, in the event that they do, testing of relevant response arrangements will be undertaken as soon as practicable.

In addition to the testing of response capability described in Table 7-7, up to eight formal exercises are planned annually, pan-Woodside, to specifically test arrangements for responding to a hydrocarbon spill to the marine environment.

7.8.7.1 Testing of Arrangements Schedule

Woodside's Testing of Arrangements Schedule aligns with international good practice for spill preparedness and response management; the testing is compatible with the IPIECA Good Practice Guide and the Australian Emergency Management Institute Handbook. In the event of a spill, enacting these arrangements will underpin Woodside's ability to implement a response across its petroleum activities. Figure 7-5 provides a condensed snapshot of Woodside's five-year rolling Testing of Arrangements Schedule.

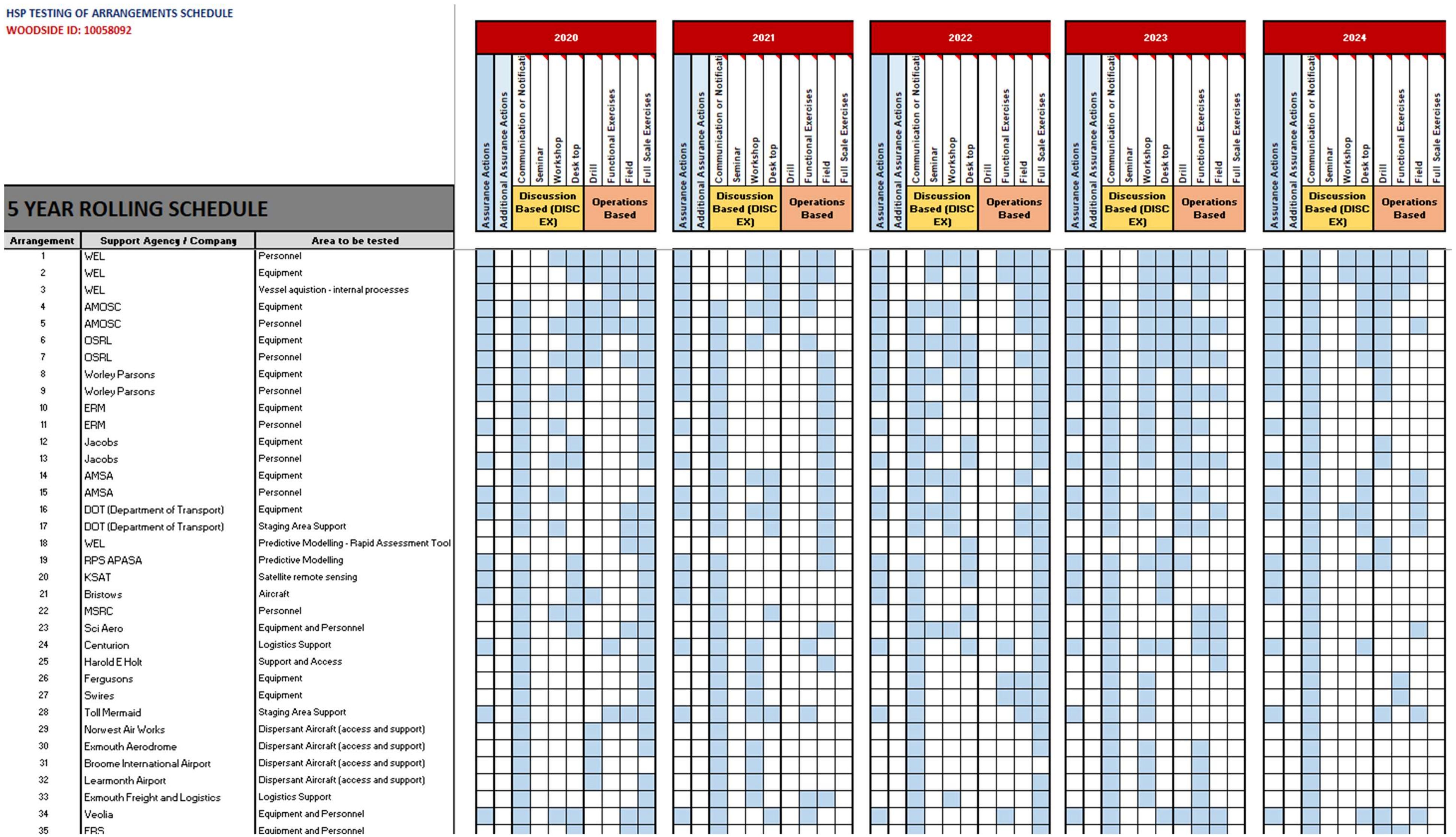

Figure 7-5: Indicative Five Yearly Testing of Arrangements Schedule (*Snapshot of a selection of OSR arrangements tested annually)*

Note: schedule is subject to change, additional detail is included in live document

Numbered hydrocarbon spill arrangements listed in the rows of the schedule are taken from Support Plans and Operational Plans described in Section 1.4 of Appendix D. Each arrangement has a support agency/company and an area to be tested (e.g. capability, equipment and personnel). For example, an arrangement could be to test Woodside's personnel capability for conducting scientific monitoring, or the ability of AMOSC to provide response personnel and equipment. In total there are approximately 75 hydrocarbon spill preparedness arrangements tested annually across the eight planned exercises, as described in Section 7.8.7.2.

The vertical columns under each year heading in Figure 7-5 relate to an individual exercise or additional assurance actions that are conducted over the five-year rolling schedule. The sub-heading for the column describes the standard method of testing (e.g. discussion exercise, desktop exercise, etc.), and the blue filled cells indicate the arrangements that could be tested for each method.

Arrangements in the schedule are tested at least once per year; however, some arrangements may be tested across multiple exercises (e.g. critical arrangements) or via other 'additional assurance' methods outside of the formal Testing of Arrangements Schedule that also constitute sufficient evidence of testing of arrangements (e.g. audits, no-notice drills, internal exercises, assurance drills etc) (refer first and second vertical columns for each year in Figure 7-5).

7.8.7.2 Exercises, Objectives & KPIs

Exercises are designed to cumulatively provide assurance for all arrangements within Woodside's testing of arrangements schedule annually across all facilities. Exercise initiating scenarios are derived from the worst-case Credible Scenarios as described in the relevant facility First Strike Plans.

Objectives and KPIs for each exercise are determined from review of:

- the testing of arrangements schedule which identifies which arrangements can be tested for each testing method (Section 7.8.7.1)
- the objectives and KPIs master generic plan which provides a summary of generic objectives and KPIs that could be tested for specific response strategies, based on industry good practice guidance (i.e. IPIECA) for testing oil spill arrangements
- the oil spill ALARP commitments register which summarises all spill response commitments from accepted Environment Plans (e.g. timings, numbers, etc.) for different response strategies, with consideration of priority commitments and worst-cast spill scenarios
- actions undertaken from recommendations out of previous exercises, where relevant .

The required capabilities, number of personnel, equipment, and timeframes (i.e. arrangements) form specific KPIs during an exercise. Where this is the case, the ALARP commitments register indicates the specific response strategy performance standards to use/test the arrangements against. Where relevant the most stringent Performance Standard across all in-force EPs is used as the KPI. Following each exercise, a report is produced that includes recommendations for improvements which are then converted to actions and tracked in the Testing of Arrangements Register.

Additional assurance actions are also routinely undertaken outside of the formal exercises (e.g. response audits, no-notice drills) which support testing of these arrangements. Evidence and outcomes from additional assurance actions are used, where relevant, to support testing individual arrangements, including from external sources (e.g. evidence of suppliers conducting testing of their own arrangements).

7.8.8 Cyclone and Dangerous Weather Preparation

Tropical cyclones and other severe weather events are a potential risk to the safety and health of personnel and can potentially cause spills of hazardous materials into the environment from infrastructure and/or damaged vessels.

The One FPSO Cyclone Evasion Procedure sets out preparation and recovery actions to be implemented in a cyclone or potential cyclone. This Procedure will be followed in the event of a cyclone or potential cyclone and includes the option of moving the Okha FPSO off station in response to severe weather.

Subsea support vessels receive regular 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 vessel's Cyclone Contingency Plan will be actioned. If required, vessels can transit from the proposed track of the cyclone (severe weather event).

7.9 Implementation Strategy and Reporting Commitments Summary

Table 7-8 provides a summary of key components within the implementation strategy.

Table 7-8: Implementation strategy and reporting commitments summary

Implementation Strategy Performance Outcome (IS Pos)	Implementation Strategy Performance Standard (IS PSs)	Implementation Strategy Measurement Criteria (IS MCs)
IS PO 1 All personnel will be aware of their roles and responsibilities regarding environmental impacts and risks throughout the Petroleum Activities Program.	**IS PS 1.1** Employees and contractors visiting the facility (that have not accessed a production facility within 12 months) will undertake the Common Production Induction prior to mobilisation.	**IS MC 1.1.1** Training attendance records
	IS PS 1.2 Offshore Woodside personnel (that do not hold Environmental Leadership Training) will complete the Offshore Environmental Awareness training on commencement in the new role and two yearly thereafter.	**IS MC 1.2.1** Training attendance records
	IS PS 1.3 Key operations leadership roles will complete the Environmental Leadership Training on commencement in the new role and three yearly thereafter.	**IS MC 1.3.1** Training attendance records
	IS PS 1.4 EP requirements for support vessels will be communicated.	**IS MC 1.4.1** One Marine Charterers Instructions distribution records
	IS PS 1.5 EP requirements for subsea support vessels will be communicated.	**IS MC 1.5.1** Subsea Environmental Implementation Package distribution records
IS PO 2 Woodside will undertake a program of periodic monitoring during the Petroleum Activities Program.	**IS PS 2.1** This information will be collected using the tools and systems outlined in Section 7.5.1.	**IS MC 2.1.1** Monitoring reports/records

Implementation Strategy Performance Outcome (IS Pos)	Implementation Strategy Performance Standard (IS PSs)	Implementation Strategy Measurement Criteria (IS MCs)
IS PO 3 Woodside will undertake environmental performance inspection and monitoring.	**IS PS 3.1** An offshore inspection will be undertaken each calendar year by the Production Environment Team to review aspects of environmental performance. All risk sources/activities applicable to the offshore facility will be reviewed over a three-year rolling period.	**IS MC 3.1.1** Records of findings available
	IS PS 3.2 Assurance related to the management of environmental risks and impacts of the facility will be completed in accordance with the Operations Division Integrated Assurance Assignment Plan.	**IS MC 3.2.1** Assurance records available
	IS PS 3.3 Environmental inspections of subsea support vessels will be undertaken annually	**IS MC 3.3.1** Records of inspections available
IS PO 4 Woodside will undertake regular reviews to monitor environmental performance.	**IS PS 4.1** Environment KPIs for the facility will be developed on an annual basis to drive continuous improvement and performance will be tracked.	**IS MC 4.1.1** KPIs and reports/scorecards tracking KPI performance available.
	IS PS 4.2 Woodside will undertake a review and submit an environmental performance report to NOPSEMA annually.	**IS MC 4.2.1** Record of submission of environmental performance reports to NOPSEMA.
IS PO 5 NOPSEMA EP reporting requirements will be met.	**IS PS 5.1** Recordable incident reports will be submitted monthly to NOPSEMA.	**IS MC 5.1.1** Report records.
	IS PS 5.2 NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations.	**IS MC 5.2.1** Record of notifications to NOPSEMA.
	IS PS 5.3 Woodside will notify NOPSEMA within ten days of completion of the activity (not expected to be applicable during the EP period).	**IS MC 5.3.1** Record of notification to NOPSEMA.
	IS PS 5.4 The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended, all of the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A.	**IS MC 5.4.1** Record of notification to NOPSEMA and NOPSEMA acceptance of notification.

Implementation Strategy Performance Outcome (IS Pos)	Implementation Strategy Performance Standard (IS PSs)	Implementation Strategy Measurement Criteria (IS MCs)
IS PO 6 Incidents and hazards will be documented, and records maintained.	**IS PS 6.1** Details outlined in Section 6 and Section 7.7.5 are documented.	**IS MC 6.1.1** Internal records available (i.e. within First Priority).
IS PO 7 Personnel holding responsibilities in an emergency will test the arrangements supporting the activities OPEP to ensure they are effective and communicated.	**IS PS 7.1** Exercises will be conducted in alignment with the frequency identified in Table 7-6. These arrangements are conducted in accordance with Regulation 14 (8B) of the Environment Regulations: • Arrangements are tested in accordance with a schedule as per the frequency identified in Table 7-6. • Arrangements will be tested when the OPEP is significantly amended.	**IS MC 7.1.1** Spill response exercise report. Records managed in Testing of Arrangements Register.
	IS PS 7.3 Close out of actions from exercising are managed in the Testing of Arrangements Register.	**IS MC 7.3.1** Records managed in Testing of Arrangements Register.
	IS PS 8.1 Activity OPEPs will be revised at a minimum of every five years.	**IS MC 8.1.1** OPEP current and available.
IS PO 8 Woodside will ensure that the arrangements supporting the activities OPEP are validated.	**IS PS 9.1** Relevant documents from the OPEP will be reviewed in the following circumstances: • implementation of improved preparedness measure • a change in the availability of equipment stockpiles • a change in the availability of personnel that reduces or improves preparedness and the capacity to respond • the introduction of a new or improved technology that may be considered in a response for this activity • to incorporate, where relevant, lessons learned from exercises or events if national or state response frameworks and Woodside's integration with these frameworks changes.	**IS MC 9.1.1** The following records with be maintained: • HSPU Testing of arrangements register (Post Exercise Actions) DRIMS 10173648 • Woodside Internal Equipment Maintenance Register (DRIMS 1400051189) • OPEP current and available.

Implementation Strategy Performance Outcome (IS Pos)	Implementation Strategy Performance Standard (IS PSs)	Implementation Strategy Measurement Criteria (IS MCs)
IS PO 9 The OPEP will only be updated under specific circumstances to ensure the information is current.	**IS PS 10.1** • Woodside will assess potential alternatives to determine compatibility with Okha subsea control system within one year of acceptance of this EP.	**IS MC 10.1.1** • Records demonstrate a subsea control fluid compatibility study has been undertaken within one year of acceptance of this EP
IS PO 10 Woodside will pursue continuous improvement by evaluating potential alternative subsea control fluids for use on the Okha facility		

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9. LIST OF TERMS AND ACRONYMS

Acronym	Description
@	At
~	Approximately
<	Less/fewer than
>	Greater/more than
≤	Less than or equal to
≥	Greater than or equal to
°C	Degrees Celsius
24/7	24 hours a day, seven days a week
3D	Three-dimensional
ACN	Australian Company Number
ACS	Australian Customs Service
AFMA	Australian Fisheries Management Authority
AHS	Australian Hydrographic Service
AIMS	Australian Institute of Marine Science
ALARP	As low as reasonably practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines (for Fresh and Marine Water Quality)
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS	Australian Standard/New Zealand Standard
bbl	Barrel
bbl/d	Barrels per day
BDV	Blow-down Valve
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BOP	Blowout Preventer
BP	Boiling Point
BTEX	Benzene, toluene, ethylbenzene, and xylene compounds
CALM	Former Western Australian Department of Conservation and Land Management (now DBCA)
CAPEX	Capital Expenditure
CCE	Common cause event
CCR	Central Control Room
CFA	Commonwealth Fisheries Association
CH_4	Methane

Acronym	Description
CI	Continuous improvement
CICC	Corporate Incident Communication Centre
cm	Centimetre
cm^3	Cubic centimetre
CMMS	Computerised Maintenance Management System
CMT	Crisis Management Team
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COO	Chief Operations Officer
cP	Centipoise
CS	Cost Sacrifice
CV	Company Value
CVS	Contractor Verification Service
CWLH	Cossack, Wanaea, Lambert, and Hermes
D&C	Drilling and Completions
DAWR	Commonwealth Department of Agriculture and Water Resources
dB re 1 µPa	Decibels relative to one micropascal; the unit used to measure the intensity of an underwater sound
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DCS	Distributed control system
DEC	Former Western Australian Department of Environment and Conservation (now DBCA)
DEH	Former Commonwealth Department of the Environment and Heritage (now DoEE)
DEWHA	Former Commonwealth Department of the Environment, Water, Heritage and the Arts (now DoEE)
DHNRDT	Deepwater Horizon Natural Resource Damage Assessment Trustees
DIIS	Commonwealth Department of Industry, Innovation and Science
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DNP	Director of National Parks
DoEE	Commonwealth Department of the Environment and Energy
DoT	Western Australian Department of Transport
DP	Dynamic positioning
DpaW	Former Western Australian Department of Parks and Wildlife (now DBCA)
DPIRD	Western Australian Department of Primary Industries and Regional Development
DPLH	Western Australian Department of Planning, Lands and Heritage
DRIMS	Document Retrieval Integrated Management System
DSEWPaC	Former Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DoEE)
eCAR	Environmental Commitments and Actions Register

Acronym	Description
EET	Emission Estimation Techniques
EEZ	Exclusive Economic Zone
EMBA	Environment that may be affected
ENVID	Environment Identification (study)
EP	Environment Plan
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPO	Environmental Performance Objective
EPS	Environment Performance Standard
ER	Emergency Response
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
FFS	Fitness for Services
FPSO	Floating production, storage, and offtake
g	Gram
GEL	Gas Export Line
GP	Good Practice
GWA	Goodwyn Alpha
ha	Hectare
HAZID	Hazard identification (study)
HP	High Pressure
HQ	Hazard Quotient
HSE	Health, Safety, and Environment
HSEC	Health, Safety and Environment Coordinator
HSEQ	Health, Safety, Environment, and Quality
HT	High Temperature
HVAC	Heating, ventilation, and air conditioning
ICSS	Integrated Control and Safety System
IMMR	Inspection, maintenance, monitoring, and repair
IMS	Invasive Marine Species
IMSMP	Invasive Marine Species Management Plan
IPIECA	International Petroleum Industry Environmental Conservation Association
ISO	International Organization for Standardization
ISSoW	Integrated Safe System of Work
ITF	Indonesian Throughflow
ITOPF	International Tanker Owners Pollution Federation Ltd
IUCN	International Union for the Conservation of Nature
KEF	Key Ecological Feature

Acronym	Description
kg	Kilogram
KGP	Karratha Gas Plant
kHz	Kilohertz
km	Kilometre
kn	Knot
KO	Knock Out (drum)
KPI	Key Performance Indicator
kW	Kilowatt
L	Litre
LAT	Lowest Astronomical Tide
LCS	Legislation, Codes and Standards
LHM	Lambert Hermes manifold
LNG	Liquefied Natural Gas
LP	Low Pressure
LT	Low Temperature
LTO	Licence to Operate
m	Metre
m/s	Metres per second
m^2	Square metre
m^3	Cubic metre
MAE	Major Accident Event
MAH	Monocyclic Aromatic Hydrocarbon
MARPOL	The International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978.
MBES	Multibeam Sonar
MC	Measurement Criteria
MEE	Major Environmental Event
MEG	Monoethylene glycol
mg	Milligram
MGO	Marine Gas Oil
ml	Millilitre
MMscfd	Million standard cubic feet per day
MNES	Matters of National Environmental Significance
MoC	Management of Change
MOPO	Manual of Permitted Operation
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MPRA	Marine Parks and Reserves Authority
MSPS	Management System Performance Standards

Acronym	Description
MVA	Megavolt-ampere
MW	Megawatt
n.d.	No date
N/A	Not Applicable
N_2O	Nitrous oxide
NERA	National Energy Resources Australia
NGERS	National Greenhouse and Energy Reporting Scheme
NIMS	Non-indigenous Marine Species
nm	Nautical mile
NMFS	National Marine Fisheries Service (US)
NOAA	National Oceanic and Atmospheric Administration (US)
NOEC	No observed effect concentrations
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NORM	Naturally Occurring Radioactive Material
NO_X	Oxides of nitrogen
NPI	National Pollutant Inventory
NRA	North Rankin Alpha
NRC	North Rankin Complex
NSW	New South Wales
NWMR	North-west Marine Region
NWS	North West Shelf
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
OIM	Offshore Installation Manager
OIW	Oil in water
OMDAMP	Offshore Marine Discharges Adaptive Management Plan
OPEA	Oil Pollution Emergency Arrangements
OPEP	Oil Pollution Emergency Plan
OPEX	Operating Expenditure
OPGGS Act	Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006*
OSPAR	Oslo–Paris Convention for the Protection of the Marine Environment of the North East Atlantic
PAH	Polycyclic aromatic hydrocarbon
PAR	Photosynthetically active radiation
PARCOM	former Paris Convention 1997/16
PAU	Pre-assembled unit
PC	Protection Concentration; e.g. PC99 is 99% protection concentration, PC95 is 95% protection concentration etc.

Acronym	Description
PEC	Predicted Effects Concentration
pH	Measure of acidity or basicity of a solution
PJ	Professional Judgement
PMST	Protected Matters Search Tool
PNEC	Predicted No Effect Concentration
PPA	Pearl Producers Association
ppb	Parts per billion
ppm	Parts per million
PSM	Process Safety Management
PSRA	Process Safety Risk Assessment
PSU	Practical salinity unit
PSZ	Petroleum safety zone
PTS	Permanent threshold shift
PW	Produced Water
RBA	Risk-based Analysis
RBI	Risk-based Inspection
RCC	Rescue Coordination Centre
RESDV	Riser Emergency Shutdown Valve
rms	Root Mean Square
RO	Reverse osmosis
ROV	Remotely operated vehicle
RTM	Riser turret mooring
SA	South Australia
SBP	Sub-bottom profiler
SCE	Safety and Environmental Critical Element
SCM	Subsea Control Module
SCQ	Safety and Environmental Critical Equipment
SCSSV	Surface controlled subsurface safety valve
SEL	Sound Exposure Level
SIMAP	Spill Impact Mapping and Analysis program
SKM	Sinclair Knight Mertz (company)
sm^3	Standard cubic metres
SMP	Scientific Monitoring Program
SOPEP	Ship Oil Pollution Emergency Plan
SO_X	Sulfur oxides
SPL	Sound Pressure Level
SSPL	Subsea Pipeline
SSS	Side Scan Sonar

Acronym	Description
SV	Societal Value
SVP	Senior Vice President
T	Tonne
TEG	Triethylene glycol
TRC	Total Residual Chlorine
TTS	Temporary threshold shift
UK	United Kingdom
UPS	Uninterrupted Power Supply; battery power system
US	United States
USBL	Ultra-short baseline
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
VP	Vice President
VRU	Vapour recovery unit
WA	Western Australia
WAF	Water-accommodated fraction
WAFIC	Western Australian Fishing Industry Council
WANPE	Wanaea Pipeline End
WC GEL	Wanaea Cossack Gas Export Line
WEL	Woodside Energy Limited
WET	Whole Effluent Toxicity
WGS84	Word Geodesic System 1984
WHA	World Heritage Area
WMS	Woodside Management System
WOMP	Well Operations Management Plan

APPENDIX A WOODSIDE HEALTH, SAFETY, ENVIRONMENT AND QUALITY AND RISK MANAGEMENT POLICIES

Health, Safety, Environment and Quality Policy

OBJECTIVES

Strong health, safety, environment and quality (HSEQ) performance is essential for the success and growth of our business. Our aim is to be recognised as an industry leader in HSEQ through managing our activities in a sustainable manner with respect to our workforce, our communities and the environment.

At Woodside we believe that process and personal safety related incidents, and occupational illnesses, are preventable. We are committed to managing our activities to minimise adverse health, safety or environmental impacts, incorporating a right first time approach to quality.

PRINCIPLES

Woodside will achieve this by:

- implementing a systematic approach to HSEQ risk management
- complying with relevant laws and regulations and applying responsible standards where laws do not exist
- setting, measuring and reviewing objectives and targets that will drive continuous improvement in HSEQ performance
- embedding HSEQ considerations in our business planning and decision making processes
- integrating HSEQ requirements when designing, purchasing, constructing and modifying equipment and facilities
- maintaining a culture in which everybody is aware of their HSEQ obligations and feels empowered to speak up and intervene on HSEQ issues
- undertaking and supporting research to improve our understanding of HSEQ and using science to support impact assessments and evidence based decision making
- taking a collaborative and pro-active approach with our stakeholders
- requiring contractors to comply with our HSEQ expectations in a mutually beneficial manner
- publicly reporting on HSEQ performance

APPLICATION

Responsibility for the application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control. Woodside managers are also responsible for promotion of this policy in non-operated joint ventures.

This policy will be reviewed regularly and updated as required.

Reviewed in December 2019

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 REPORTS

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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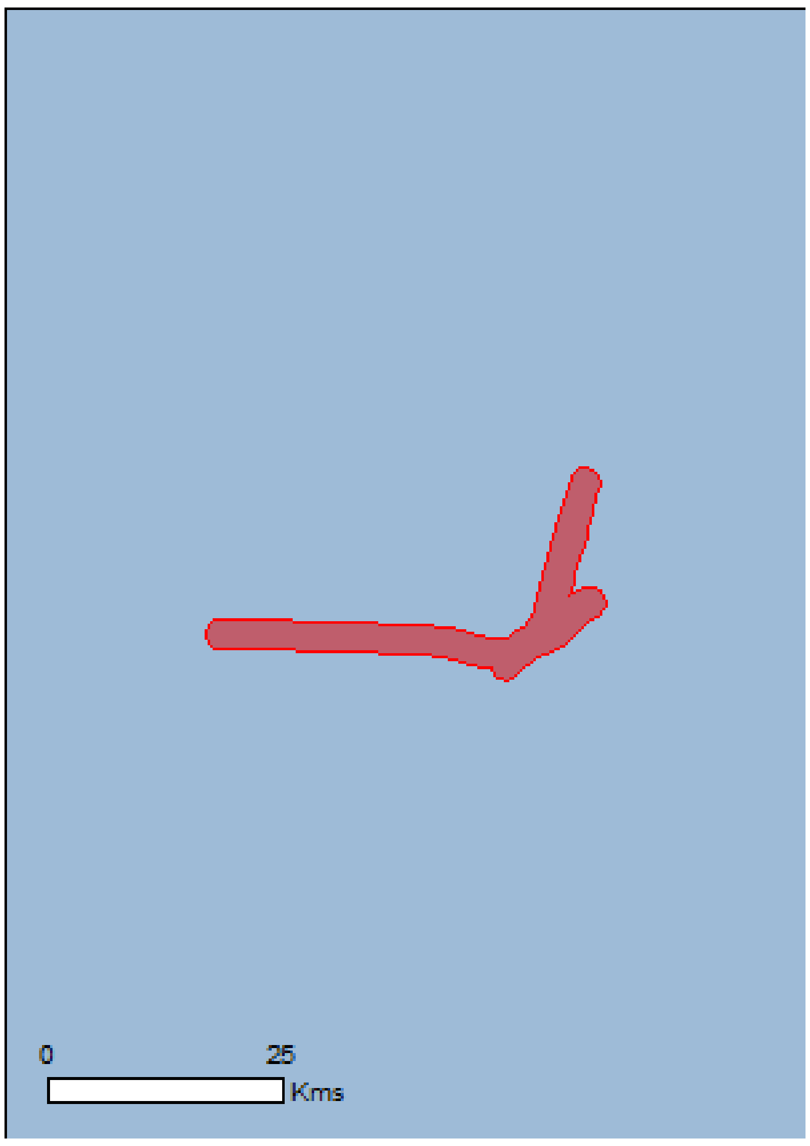

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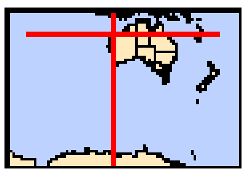

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	15
Listed Migratory Species:	31

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	55
Whales and Other Cetaceans:	23
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	1

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Fish		

Name	Threatened	Type of Presence
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area

Name	Status	Type of Presence
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.5505 116.4735,-19.54309 116.4893,-19.54231 116.4937,-19.54278 116.498,-19.54511 116.503,-19.5492 116.5068,-19.55437 116.5086,-19.55959 116.5083,-19.56336 116.5067,-19.56732 116.5033,-19.57137 116.4958,-19.57529 116.4909,-19.59535 116.4682,-19.6005 116.4569,-19.60459 116.442,-19.62318 116.4222,-19.62531 116.4184,-19.62628 116.4144,-19.62594 116.4094,-19.62387 116.4046,-19.62057 116.401,-19.61613 116.3987,-19.61489 116.3882,-19.60593 116.3534,-19.60266 116.3286,-19.59865 116.1701,-19.59883 116.1383,-19.5977 116.1336,-19.59507 116.1295,-19.5914 116.1266,-19.58675 116.1252,-19.58253 116.1254,-19.57825 116.1272,-19.57486 116.1303,-19.5726 116.1345,-19.57177 116.139,-19.57149 116.1674,-19.57559 116.3302,-19.57952 116.3601,-19.58864 116.3955,-19.58922 116.4032,-19.58815 116.4131,-19.58252 116.4216,-19.57897 116.4296,-19.57311 116.4352,-19.56989 116.4369,-19.52316 116.4498,-19.4799 116.4633,-19.45863 116.4691,-19.44454 116.4742,-19.44047 116.4767,-19.43735 116.4806,-19.43569 116.4852,-19.43562 116.4901,-19.43758 116.4957,-19.44155 116.5001,-19.44665 116.5026,-19.45187 116.503,-19.45692 116.5019,-19.46145 116.4995,-19.47628 116.4957,-19.49 116.4912,-19.49369 116.4915,-19.49719 116.4909,-19.50328 116.4872,-19.51191 116.4847,-19.51757 116.4841,-19.52331 116.4813,-19.53202 116.4787,-19.53587 116.4791,-19.53958 116.4785,-19.5456 116.4749,-19.5505 116.4735

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

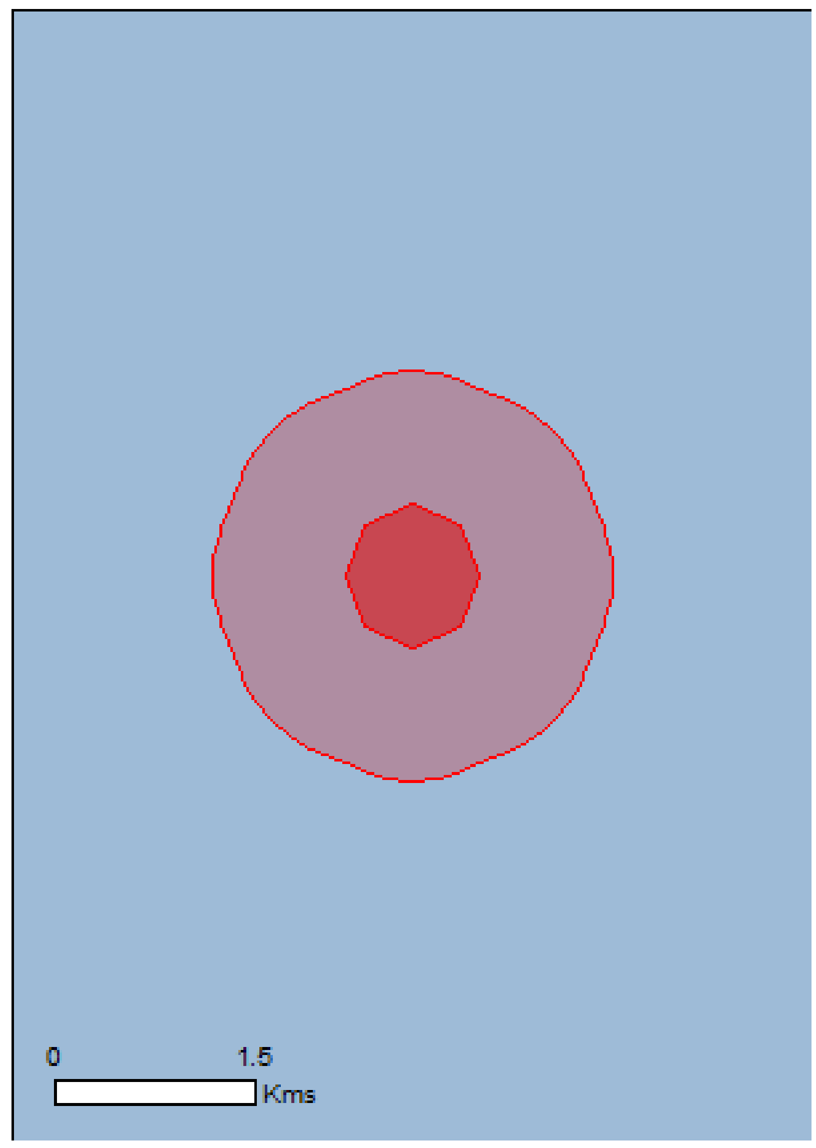
EPBC Act Protected Matters Report

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.

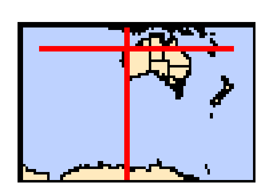
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 15/04/19 14:55:48



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	15
Listed Migratory Species:	30

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	55
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat 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 likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Fish		

Name	Threatened	Type of Presence
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

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
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

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- seals which have only been mapped for breeding sites near the Australian continent

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Coordinates

-19.49962 116.5979,-19.50095 116.6011,-19.50415 116.6024,-19.50734 116.6011,-19.50866 116.5979,-19.50733 116.5947,-19.50413 116.5934,-19.50094 116.5947,-19.49962 116.5979

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Canberra ACT 2601 Australia
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EPBC Act Protected Matters Report

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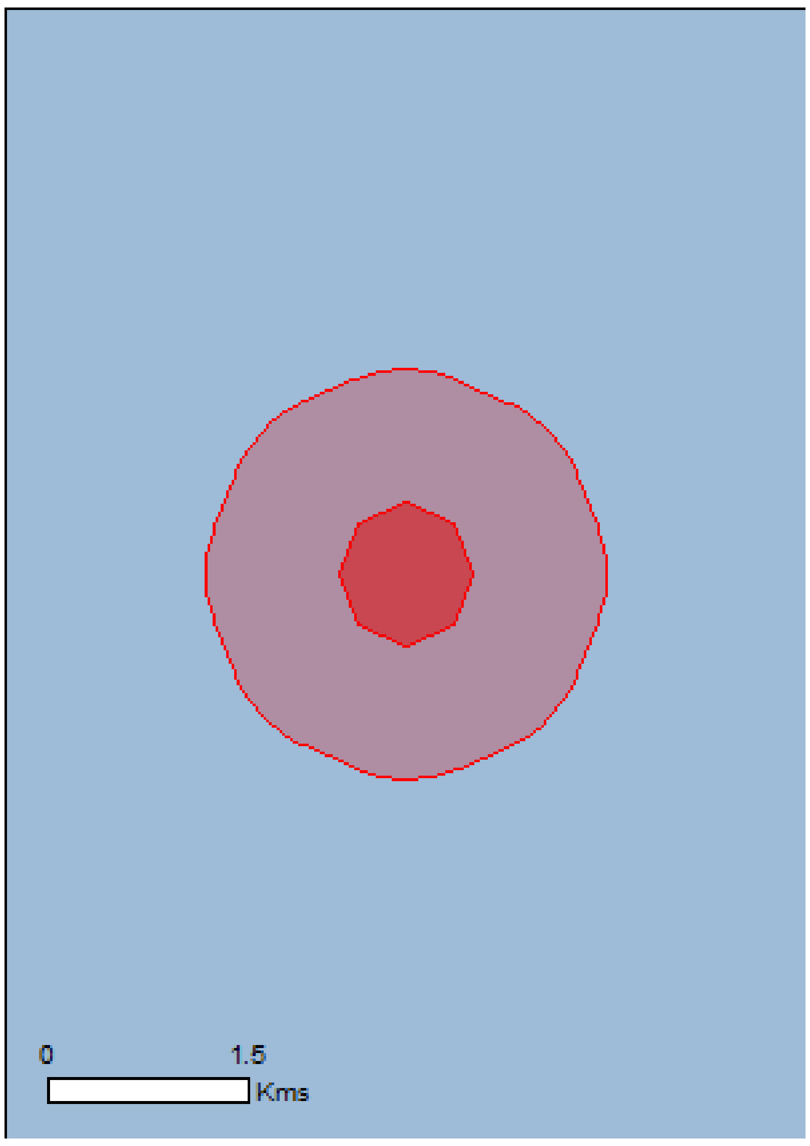

Coordinates
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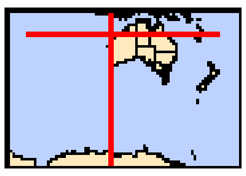

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	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:	14
Listed Migratory Species:	30

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	47
Whales and Other Cetaceans:	22
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	1

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Fish		
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area

Name	Status	Type of Presence
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
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Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west

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Australian Government
Department of the Environment and Energy

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Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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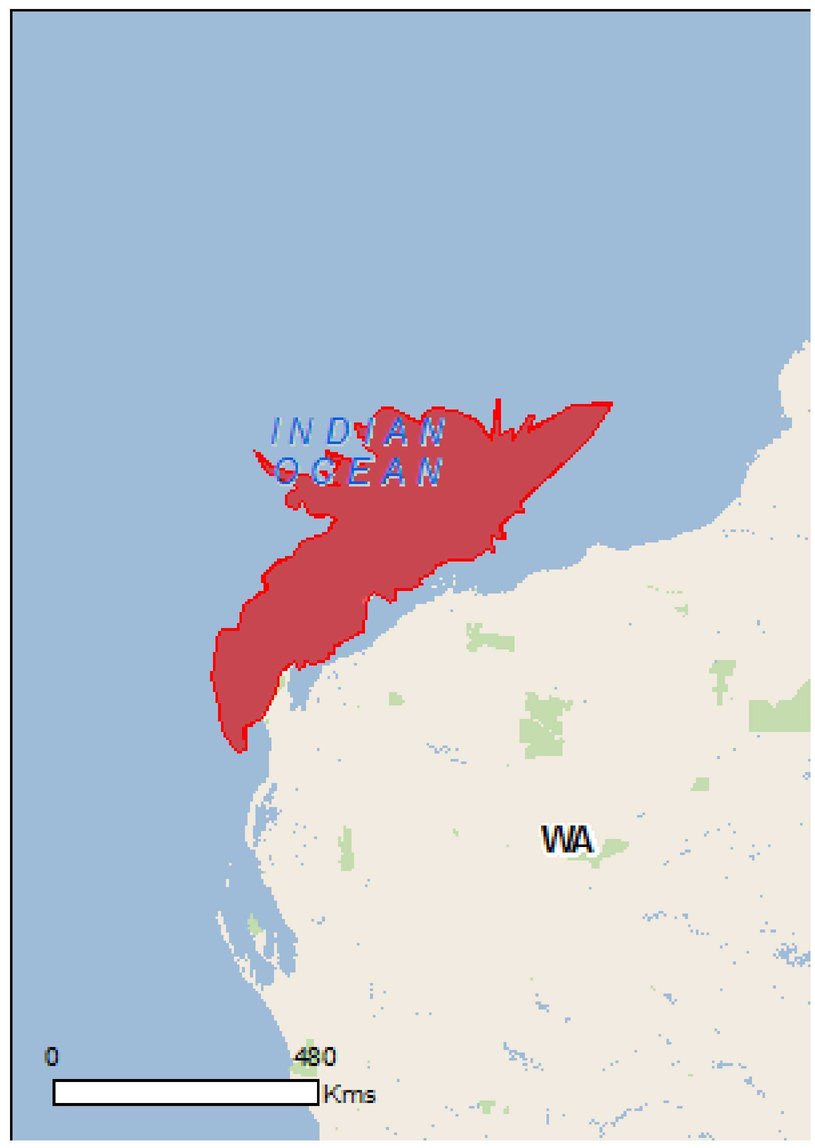
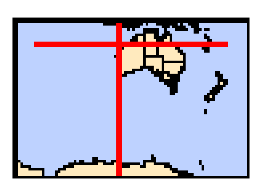


Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	41
Listed Migratory Species:	56

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	2
Commonwealth Heritage Places:	2
Listed Marine Species:	105
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	6

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	15
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	7

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

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 known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
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

Name	Status	Type of Presence
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 impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat 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

Name	Status	Type of Presence
Osphranter robustus isabellinus		
Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale lateralis lateralis		
Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Other		
Kumonga exleyi		
Cape Range Remipede [86875]	Vulnerable	Species or species habitat 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		
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

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat 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

Name	Threatened	Type of Presence
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 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

Name	Threatened	Type of Presence
		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 known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica		
Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus		
Osprey [952]		Breeding known to occur within area
Thalasseus bergii		
Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - LEARMONTH - AIR WEAPONS RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Learmonth Air Weapons Range Facility	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
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
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to

Name	Threatened	Type of Presence
		occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
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

Name	Threatened	Type of Presence
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
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

Name	Threatened	Type of Presence
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	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		

Name	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
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	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
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

Name	Status	Type of Presence
		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
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Airlie Island	WA
Barrow Island	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Cape Range	WA
Jurabi Coastal Park	WA
Lowendal Islands	WA
Montebello Islands	WA
Muiron Islands	WA
Round Island	WA
Serrurier Island	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA41080	WA

Name	State
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 within area

Nationally Important Wetlands [Resource Information]

Name	State
Cape Range Subterranean Waterways	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.58504 113.66457,-22.7547 113.36396,-23.06375 113.37809,-23.11618 113.25119,-22.88264 113.0513,-22.556 112.96702,-22.42229 112.96955,-21.99185 112.82821,-21.76761 112.88008,-21.42163 112.9115,-21.25396 113.01587,-21.24157 113.25946,-20.87838 113.34742,-20.63147 113.72613,-20.42098 113.67495,-20.20549 113.90803,-20.14958 114.1243,-19.88452 114.32363,-19.77562 114.71243,-19.55404 114.85848,-19.47518 114.74917,-19.4961 114.62068,-19.46804 114.45231,-19.26088 114.32895,-19.38924 114.20903,-19.31441 114.05061,-19.1997 114.03572,-19.06112 114.21955,-18.80972 113.74008,-18.65678 113.62902,-18.52707 113.58001,-18.7457 113.79987,-18.81325 114.08473,-18.86804 114.39179,-19.00627 114.62452,-19.032 114.89855,-18.8245 114.61248,-18.85497 114.84366,-18.63599 114.90355,-18.62066 114.70709,-18.51286 114.69826,-18.68764 115.33112,-18.5614 115.53417,-18.412 115.32941,-18.3209 115.40383,-18.25399 115.24497,-18.0709 115.20392,-18.1182 115.37752,-17.91674 115.55477,-17.83134 115.60749,-17.82543 115.6288,-17.82702 115.67086,-17.82215 115.72021,-17.83122 115.78304,-17.86843 115.87988,-18.06325 116.24493,-17.85823 116.35117,-17.8238 116.52822,-17.85268 116.79447,-17.97765 117.12814,-18.31697 117.42738,-17.69251 117.52443,-18.25918 117.52806,-18.14418 117.75745,-18.33313 117.75884,-17.94224 118.03136,-17.94456 118.12297,-18.19178 118.02432,-17.95311 118.47544,-17.76984 118.73385,-17.76927 119.37564,-18.28274 119.02555,-18.52755 118.78621,-19.29519 117.89941,-19.45106 117.923,-19.42046 117.79594,-19.64985 117.56782,-19.83308 117.60437,-19.81345 117.40549,-20.04406 117.4473,-20.00653 117.32734,-20.17482 117.11418,-20.17174 116.82879,-20.18318 116.77124,-20.28148 116.51029,-20.3802 116.44901,-20.46582 116.22388,-20.54759 116.24885,-20.62872 116.08795,-20.64536 115.83697,-20.80621 115.82221,-20.83066 115.76379,-20.73943 115.6752,-20.67802 115.49951,-20.70172 115.42688,-20.8327 115.3488,-20.98762 115.3552,-21.26064 115.29808,-21.36662 115.12031,-21.43316 114.96601,-21.50692 114.82554,-21.59471 114.83495,-21.61723 114.74748,-21.69018 114.72893,-21.73757 114.60402,-21.77852 114.48661,-21.71826 114.3609,-21.80485 114.34848,-21.84788 114.27399,-21.72959 114.19503,-21.76624 114.12814,-21.83491 114.03408,-21.90487 113.96499,-22.1734 113.85059,-22.31184 113.80909,-22.58504 113.66457

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 and Response Mitigation Assessment for Okha Floating Production Storage and Offloading Facility Operations Environment Plan

Security & Emergency Management
Hydrocarbon Spill Preparedness Unit

October 2019
Revision: 1

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

Woodside Energy Ltd (Woodside) has developed its oil spill preparedness and response position for the Okha FPSO Facility Operations, hereafter known as the Petroleum Activities Program (PAP).

This document demonstrates that the risks and impacts from an unplanned hydrocarbon release, and the associated response operations, are controlled to As Low As Reasonably Practicable (ALARP) and Acceptable levels. It achieves this by evaluating response options to address the potential environmental impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the Environment Plan (EP). This document then outlines Woodside's decisions and techniques for responding to a hydrocarbon release event and the process for determining its level of hydrocarbon spill preparedness.

A summary of the key facts and references to additional detail within this document are presented below.

Table 0-1: Summary of the key details for assessment

Key details of assessment	Summary	Reference to additional detail
Worst Case Credible Scenarios (WCCS)	**Scenario MEE-01: Hydrocarbon release caused by a well loss of containment** Subsea release of 185,915 m^3 over 77 days of Cossack Light Crude from Lambert well LH3 (19° 26' 58.47" S, 116° 29' 16.23" E). 15.3% residual component of 28,445 m^3	Section 1.1
	Scenario MEE-03: Hydrocarbon release due to a support vessel tank rupture Instantaneous surface release of 105 m^3 marine diesel from a support vessel at Site 3 (19° 35' 21.00" S, 116° 26' 48.00" E). 5% residual component of 5.25 m^3.	
	Scenario MEE-05: Hydrocarbon release caused by a vessel cargo tank rupture Surface release of 30,302 m^3 over 24 hours of Cossack Light Crude near Lambert well LH3 (19° 35' 21.00" S, 116° 26' 48.00" E). 15.3% residual component of 4,636 m^3	
Hydrocarbon Properties	**Cossack Light Crude (API 48.1)** Contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 12.0% 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 < 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 (50 m^3). 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	Section 6 of the EP Appendix A of the First Strike Plan (FSP)

<table>
<tr><td></td><td>points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.</td><td></td></tr>
<tr><td>Modelling Results</td><td>Stochastic modelling

A quantitative, stochastic assessment has been undertaken for credible spill scenarios to help assess the environmental risk of a hydrocarbon spill.

A total of 100 replicate simulations were completed for Scenario 1 (MEE-01) over an annual period 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). For Scenario 5 (MEE-05) a total of 200 replicate simulations were run over an annual period (50 simulations per quarter).

Deterministic modelling

Deterministic modelling was then undertaken for scenarios MEE-01 and MEE-05 (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)

Results as follows:
<table>
<tr><th></th><th>Scenario MEE-01: Hydrocarbon release caused by a well loss of containment</th><th>Scenario MEE-05: Hydrocarbon release caused by a vessel cargo tank rupture</th></tr>
<tr><td>Minimum time to shoreline contact (above 100 g/m^2)</td><td>Model 12, Q3
14.2 days at Barrow Island (2 m^3)</td><td>Model 24, Q2
7.2 days (Barrow Island – 42 m^3)</td></tr>
<tr><td>Largest volume ashore at any single Response Priority Area (RPA) (above 100 g/m^2)</td><td>Model 3, Q2
65.8 m^3 at Pilbara Islands – Southern Islands Group (43 days)</td><td>Model 32, Q2
110 m^3 (Montebello Islands and Montebello Islands State Marine Park – 11.1 days)</td></tr>
<tr><td>Largest total shoreline accumulation (above 100 g/m^2) across all shorelines</td><td>Model 23, Q2
124.9 m^3 (Pilbara Islands – Southern Islands Group is first/worst receptor impacted)</td><td>Model 32, Q2
165.5 m^3 (Montebello Islands and Montebello Islands State Marine Park)</td></tr>
</table></td><td>Section 2.3</td></tr>
<tr><td>Net Environmental Benefit Assessment</td><td>Monitor and evaluate, source control via remotely operated vehicle (ROV) intervention, source control via relief well drilling, source control (vessel), subsea dispersant injection, surface dispersant spraying, containment and recovery, protection and deflection, shoreline clean-up, oiled wildlife response, are all identified as potentially having a net environmental benefit (dependent on the actual spill scenario) and carried forward for further assessment.</td><td>Section 4</td></tr>
</table>

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 Okha FPSO Facility Operations, hereafter known as the PAP. This document outlines Woodside's decisions and techniques for responding to a hydrocarbon loss of containment event and the process for determining its level of hydrocarbon spill preparedness.

1.2. Purpose

This document, together with the documents listed below, meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Environment Regulations) relating to hydrocarbon spill response arrangements.

- The Okha FPSO Facility Operations EP
- Oil Pollution Emergency Arrangements (OPEA) (Australia)
- The Okha FPSO Facility Operations Oil Pollution Emergency Plan (OPEP) including
  - First Strike Plan (FSP)
  - Relevant Operations Plans
  - Relevant Tactical Response Plans (TRPs)
  - Relevant Supporting Plans
  - Data Directory.

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 to ALARP and Acceptable levels.

1.3. Scope

This document demonstrates that the risks and impacts from an unplanned hydrocarbon release, and the associated response operations, are controlled to ALARP and Acceptable levels. It achieves this by evaluating 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. 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. 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: Net Environmental Benefit Analysis detailed outcomes 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.

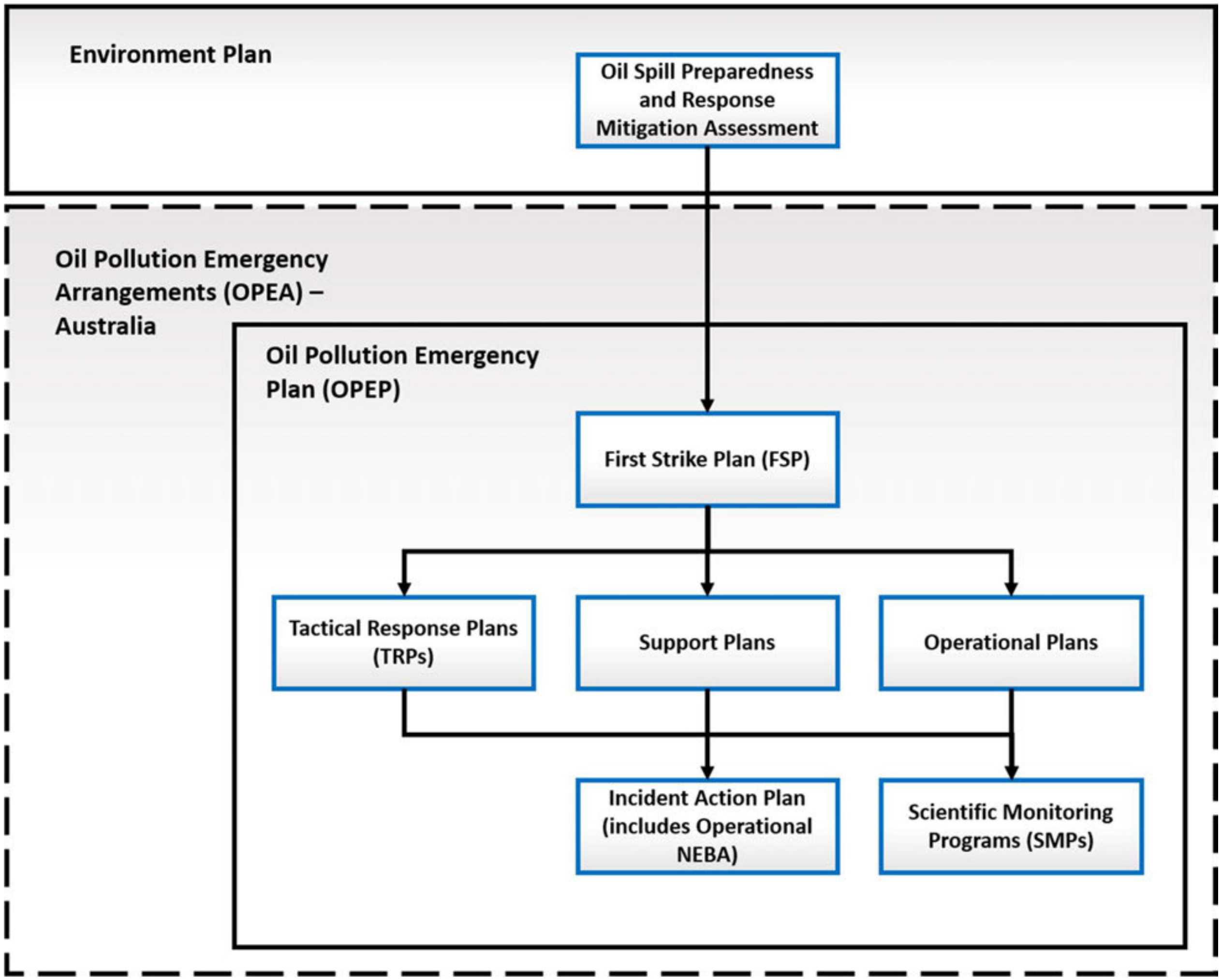

Figure 1-1: Woodside hydrocarbon spill document structure

Table 1-1: Hydrocarbon Spill preparedness and response – document references

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
Okha FPSO Facility Operations EP	Demonstrates that potential adverse impacts on the environment associated with the Okha FPSO Facility Operations (during both routine and non-routine operations) are mitigated and managed to ALARP and will be of an acceptable level.	NOPSEMA Woodside internal	EP Section 6 (Identification and evaluation of environmental risks and impacts, including credible spill scenarios) EP Section 7 (Implementation strategy – including emergency preparedness and response) EP Section 7 (Reporting and compliance) EP Section 7 (Performance outcomes, standards and measurement criteria)	
Oil Pollution Emergency Arrangements (OPEA) Australia	Descr bes 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 Okha FPSO Facility Operations (this document)	Evaluates response options to address the potential environmental impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the EP.	Regulatory agencies Corporate Incident Control Centre (CICC): Control function in an ongoing spill response for activity-specific response information.	All Performance outcomes, standards and measurement criteria related to hydrocarbon spill preparedness and response are included in this document.	
Okha FPSO Facility Operations Oil Pollution FSP	Facility specific document providing details and tasks required to mobilise a first strike response. Primarily applied to the first 24 hours of a response until a full IAP specific to the event is developed. Oil Pollution First Str ke Response Plans are intended to be the first document used to provide immediate guidance to the responding IMT.	Site-based IMT for initial response, activation and notification. CICC for initial response, activation and notification. CICC: Control function in an ongoing spill response for activity-	Initial notifications and reporting required within the first 24 hours of a spill event. Relevant spill response options that could be initiated for mobilisation in the event of a spill. Recommended pre-planned tactics. Details and forms for use in immediate response. Activation process for oil spill trajectory modelling, aerial surveillance and oil spill tracking buoy details.	

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
		specific response information.		
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 FSP; additional operational plans will be activated depending on the nature and scale of the release.	CICC: Operations and Logistics functions for first str ke 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 (TRPs)	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 Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek Barrow and Lowendal Islands Montebello Island - Stephenson Channel Nth TRP Montebello Island Champagne Bay and Chippendale channel TRP Montebello Island - Claret Bay TRP Montebello Island - Hermite/Delta Island Channel TRP Montebello Island - Hock Bay TRP Montebello Island - North and Kelvin Channel TRP

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
				Montebello Island - Sherry Lagoon Entrance TRP Pilbara Islands - Southern Island Group Shark Bay Areas 1-11 Exmouth Gulf Muiron Islands
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 IT (First Strike Response) IT (Extended Response) Communications (First Str ke 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 Okha FPSO Facility Operations FSP then summarises the outcome of the response planning process and provides initial response guidance and a summary of ongoing response activities, if an incident were to occur.

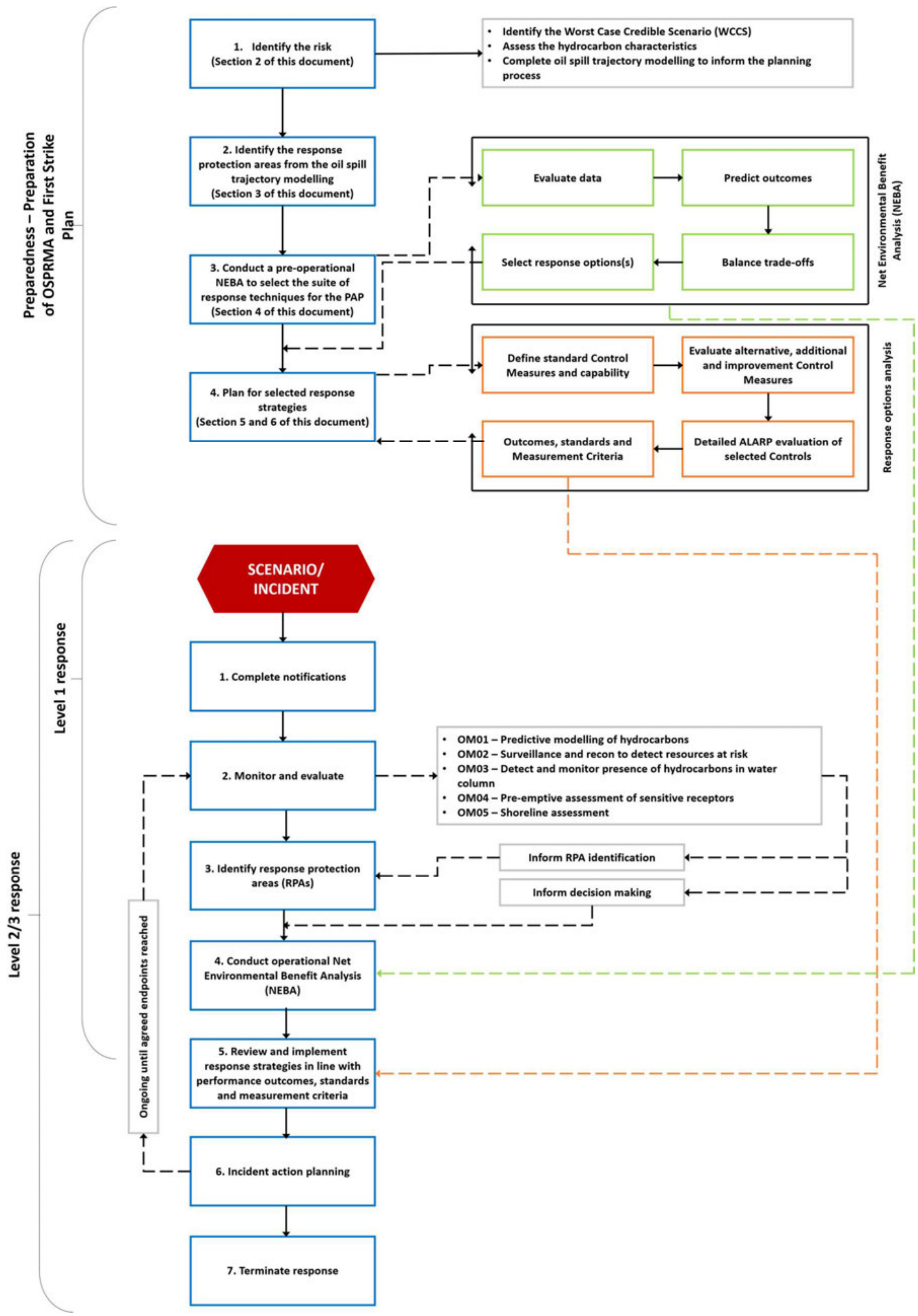

Figure 2-1: Response planning and selection process

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

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. Five 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.

Loss of well containment scenario (MEE-01) has been modelled and considered to determine the WCCS for response planning purposes.

The hydrocarbon release caused by a vessel cargo tank rupture (MEE-05) is considered the worst case when responding to floating hydrocarbons, given the large volume released over a short period of time. As such this scenario is used to scale the surface and shoreline response.

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)	Incident Level	Hydrocarbon (HC) type	Residual proportion	Residual volume (liquid m^3)	Key credible scenarios informing response planning
MEE-01	Yes	Hydrocarbon release caused by well loss of containment after a loss of well control	185,915	3	Cossack Light Crude	15.3%	369 m^3 per day	A long-term (77-day) uncontrolled subsea release from Lambert Well LH3, representing loss of containment after a loss of well control
MEE-02*	No	Hydrocarbon release caused by flowline or riser rupture	773	2	Cossack Light Crude	15.3%	118 m^3	An instantaneous subsea release (over 10 seconds) at Site 2 due to a flowline or riser rupture at the midpoint of the WC Production Line flowline
MEE-03*	No	Hydrocarbon release caused by support vessel tank rupture	105	1	Marine diesel	5%	5.25 m^3	An instantaneous surface release of diesel at Site 3 due to a support vessel tank rupture
MEE-04*	No	Hydrocarbon release caused by offtake system failure or incident	724	2	Cossack Light Crude	15.3%	111 m^3	An instantaneous surface at Site 3 due to an offtake system failure or incident
MEE-05	Yes	Hydrocarbon release caused by vessel cargo tank rupture	30,302	3	Cossack Light Crude	15.3%	4,636 m^3	A short-term (24-hour) uncontrolled surface release representing loss of containment after a vessel cargo tank rupture

**These scenarios had previously been modelled for the original Okha EP (RPS, 2013) and were re-analysed at new thresholds applying contemporary receptor boundary definitions to align with the new scenarios (MEE-01 and MEE-05).*

[1] A full description of MEEs used in this document is included in EP Section 6.8.

2.2.1. Hydrocarbon characteristics

The hydrocarbon characteristics for the WCCS are as follows. More detailed hydrocarbon characteristics, including modelled weathering data and ecotoxicity, are included in Section 6 of the EP.

Cossack Light Crude

Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 12.0% 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. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers.

The whole oil has low asphaltene content (<0.05%), 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 14.5% by mass of the whole oil, with a moderate proportion (7.4%) in the C4-C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing 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. Group two oils are a mixture of volatile and persistent hydrocarbons, with approximately 40-50% by mass predicted to evaporate over the first day or two, depending upon the prevailing conditions, with further evaporation slowing over time.

Modelling shows 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. Under these 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.

It is predicted that 5.25 m^3 of product would remain after weathering from the WCC 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

Quantitative, stochastic modelling was completed for the scenarios presented in Table 2-1 to help assess the environmental consequences of a hydrocarbon spill.

A total of 100 replicate simulations were completed for scenario 1 (MEE-01) over an annual period 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). For scenario 5 (MEE-05) a total of 200 replicate simulations were run over an annual period (50 simulations per quarter). MEE-02, MEE-03 and MEE-04 had previously been modelled for the original Okha EP (RPS, 2013) and were just re-analysed at new thresholds applying contemporary receptor boundary definitions to align with the new scenarios. Further details relating to the assessments for the scenarios can be found in Section 6.8.1.2 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 6.8.1.2 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 6.8.1.2 of the EP.

Table 2-2: Summary of thresholds applied to the stochastic hydrocarbon spill modelling to determine EMBA and environmental impacts

Floating Oil Concentration (g/m²)	Shoreline Oil Concentration (g/m²)	Entrained Oil Concentration (ppb)	Dissolved Aromatic Hydrocarbon Concentration (ppb)
1	10	10	10
10	100	100	50
50	1,000	500	400
			500

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 km² 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 km² 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 Okha FPSO Facility Operations loss of well control 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 thickness across the cell in g/m²
- Column E represents the viscosity of the hydrocarbon in centistokes (cSt) at sea surface temperature
- Column F and G represent the mass of hydrocarbon across the entire cell in kg and tonnes (rounded to nearest whole tonne) respectively.

Table 2-3: Example deterministic modelling data

Latitude	Longitude	Time_hour	Conc_gm²	Visc_cSt	Mass_kg	Mass tonnes
A	B	C	D	E	F	G
-19.449291	116.445009	6	2.337393	82.261904	2346.834779	2
-19.458323	116.454564	6	3.904446	82.019348	3919.990957	4
-19.449291	116.454564	6	10.141920	82.122816	10182.875395	10
-19.440258	116.454564	6	1.559455	82.177729	1565.840662	2
-19.458323	116.464119	6	8.628178	81.472017	8662.519664	9
-19.449291	116.464119	6	13.686730	81.834673	13741.982430	14
-19.467355	116.473674	6	1.192110	79.455729	1196.785212	1
-19.458323	116.473674	6	23.075033	79.218639	23166.844726	23
-19.449291	116.473674	6	2.359922	81.058523	2346.834779	2

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 1.1). 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

The surface thickness of oil at which dispersants are typically effective is approximately 100 g/m^2. However, substantial variations occur in the thickness of the oil within the slick, and most fresh crude oils spread within a few hours, so that overall the average thickness is 0.1 mm (or approx. 100 g/m^2) (International Tanker Owners Pollution Federation [ITOPF] 2011). Additionally, the recommended rate of application for surface dispersant is typically 1-part dispersant to 20 or 25 parts of spilled oil. These figures assume a 0.1 mm slick thickness, averaged over the thickest part of the spill, to calculate a litres/hectare application rate from vessels and aircraft. In practice, this can be difficult to achieve as it is not possible to accurately assess the thickness of the floating oil.

Some degree of localised over-dosage and under-dosage is inevitable in dispersant response. An average oil layer thickness of 0.1 mm is often assumed, although the actual thickness can vary over a wide range (from less than 0.0001 mm to more than 1 mm) over short distances (International Petroleum Industry Environment Conservation Association [IPIECA] 2015).

Guidance from the Australian Maritime Safety Authority (AMSA, 2015) indicates that spreading of spills of Group II or III products will rapidly decrease slick thickness over the first 24 hours of a spill resulting in the potential requirement of up to a ten (10) fold increase in capability on day 2 to achieve the same level of performance.

Further guidance from the European Maritime Safety Authority (EMSA) states that spraying the 'metallic' looking area of an oil slick (Bonn Agreement Oil Appearance Code [BAOAC] 3, approx. 5 – 50 µm) with dispersant from spraying gear designed to treat an oil layer 0.1 mm (100 µm) thick, will inevitably cause dispersant over-treatment by a factor of 2 to 20 times (EMSA 2012).

[2] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

[3] At 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.

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 the National Oceanic and Atmospheric Administration (NOAA) in the United States 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 (50g/m^2 is an average of 50% coverage of 0.1mm Bonn Agreement Code 4 – discontinuous true oil colour, or 25% coverage of 0.2mm Bonn Agreement Code 5 – continuous true oil colour which would represent small patches of thick oil or wind-rows.

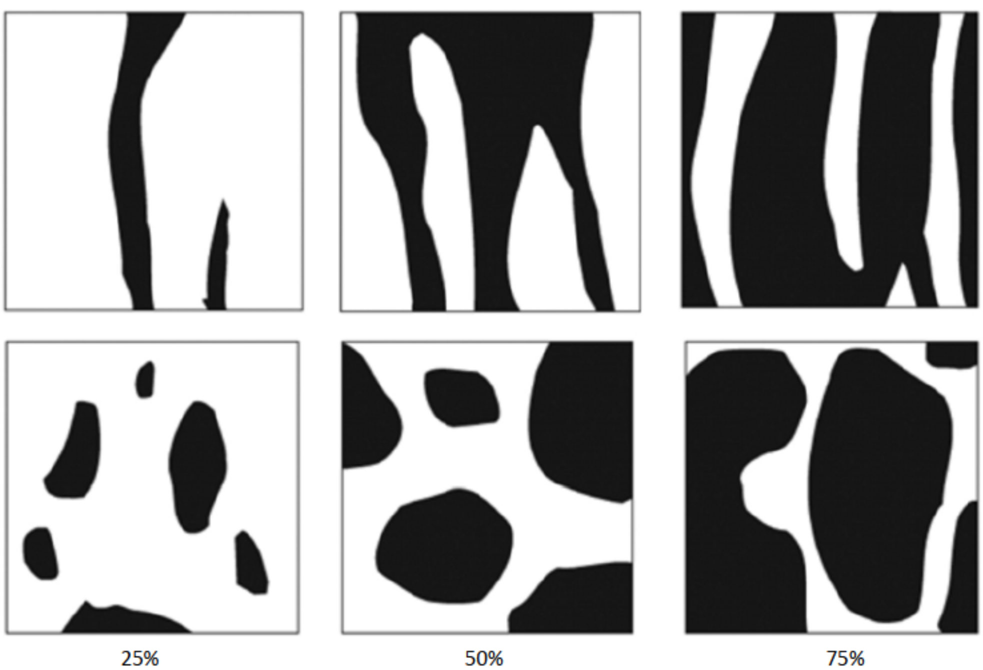

Figure 2-3: Proportion of total area coverage (AMSA, 2014)

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.

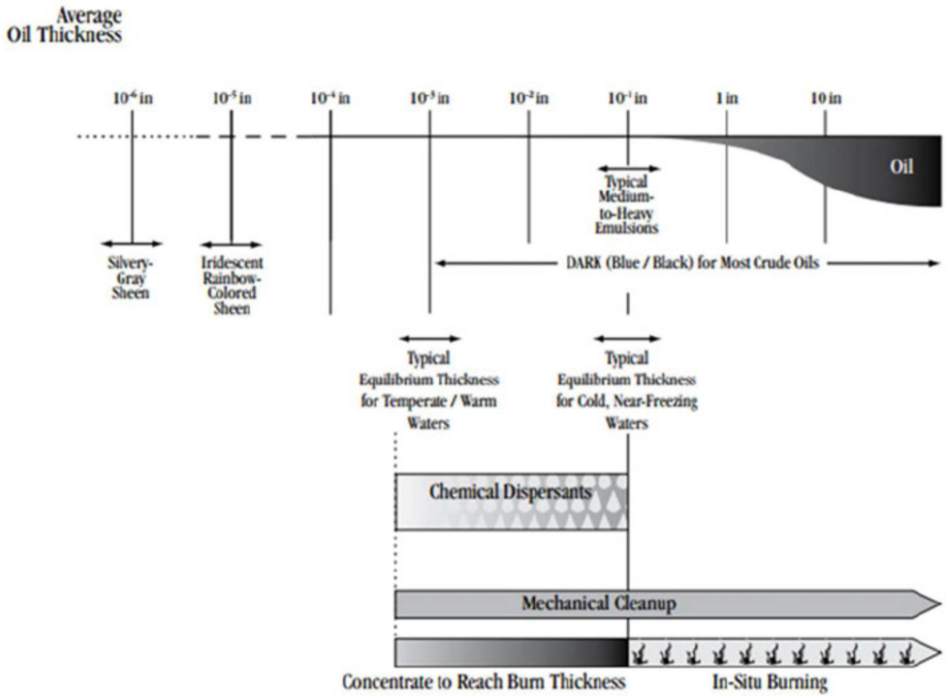

Figure 2-4: Oil thickness versus potential response options (from Allen & Dale 1996)

Wind and wave influences on the feasibility of response operations are also considered below:

- 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 (approximately 50 g/m^2) to hundredths of an inch (approximately 250 g/m^2). Improved dispersants, higher dose rates, and multiple-pass techniques may extend the thickness limitation to 2.5 mm or more.
- Mechanical clean-up: effectiveness drops significantly because of entrainment and/or splash-over as short period waves develop beyond 0.6–0.9 m in height. Waves and wind can also be limiting factors for the safe operation of vessels and aircraft.

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	500-5,000
15,000*	Predicted maximum viscosity for effective surface dispersant operations	Sometimes possible to disperse	5,000-15,000

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 (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/m2).
- Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m2).
- Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb).
- Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors.
- Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor.

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. Scenario MEE-01 has no contact at 10 g/m2. Stochastic modelling results for marine diesel (MEE-03) showed no shoreline contact at any threshold thus deterministic modelling was not undertaken for this scenario.

Table 2-6).

2.3.3. Spill modelling results

The selected deterministic runs used to represent the WCCS are based on response thresholds:

- Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2).
- Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2).
- Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb).
- Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors.
- Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor.

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. Scenario MEE-01 has no contact at 10 g/m^2. Stochastic modelling results for marine diesel (MEE-03) showed no shoreline contact at any threshold thus deterministic modelling was not undertaken for this scenario.

Table 2-6: Worst case credible scenario modelling results

Response parameter	Modelled result	
	Scenario MEE-01: Hydrocarbon release caused by a well loss of containment	**Scenario MEE-05: Hydrocarbon release caused by a vessel cargo tank rupture**
Maximum continuous liquid hydrocarbon release rate and duration	Hydrocarbon release caused by a well loss of containment – subsea release of 185,915 m^3 over 77 days of Cossack Light Crude	Hydrocarbon release caused by a vessel cargo tank rupture – surface release of 30,302 m^3 over 24 hours of Cossack Light Crude.
Maximum residual surface hydrocarbon after weathering	15.3% residual component – 4,636 m^3 of Cossack Light Crude	15.3% residual component – 28,445 m^3 of Cossack Light Crude.
Deterministic modelling results		
Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	14.2 days at Barrow Island (2 m^3) Model 12, Q3	7.2 days at Barrow Island (42 m^3) Model 24, Q2
Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2)	No contact >10 g/m^2 (*13.6 days to contact at 1 g/m^2 at Pilbara Islands – Southern Islands Group*) Model 11, Q2	7.7 days at Montebello State Marine Park Model 2, Q2
Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m^2 accumulation concentration)	124.9 m^3 (Pilbara Islands – Southern Islands Group is first/worst receptor impacted) Model 23, Q2	165.5 m^3 (Montebello Islands and Montebello Islands State Marine Park is first/worst receptor impacted) Model 32, Q2
Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor	65.8 m^3 at Pi bara Islands – Southern Islands Group (43 days) Model 3, Q2	110 m^3 at Montebello Islands and Montebello Islands State Marine Park (11 days) Model 32, Q2
Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb)	9.1 days at Montebello Islands (515 ppb) Model 14, Q2	5.7 days at Montebello Islands (2,564 ppb) Model 24, Q2

The maps below display the predicted surface concentration of oil at 50–200 g/m^2 (BAOAC Code 4 – discontinuous true oil colour - brown) and 200 g/m^2 and above (BAOAC Code 5 – continuous true oil colour - black) over the initial seven days of the two scenarios and have been chosen for planning purposes.

As shown in the figures below and from analysis of the deterministic results, modelling predicts the following:

- The subsea release results in surface concentrations below thresholds suitable for containment and recovery and surface dispersant operations during the first seven days (MEE-01, Figure 2.5).
- The surface release results in surface concentrations at thresholds suitable for containment and recovery and surface dispersant operations on Days 1 and 2 and for part of Day 3 (MEE-05, Figure 2.6).
- Spreading and weathering of the surface oil occurs rapidly due to the loss of light, volatile components.
- The maximum modelled viscosity of Cossack Light Crude for the duration of MEE-01 is 166 cSt.
- Response operations cannot be implemented if the safety of response personnel cannot be guaranteed. Safety circumstances that limit the execution of this control measure include volatile concentrations of hydrocarbons in the atmosphere, high winds (>20 knots), waves and/or sea states (>1.5m waves) and high ambient temperatures.

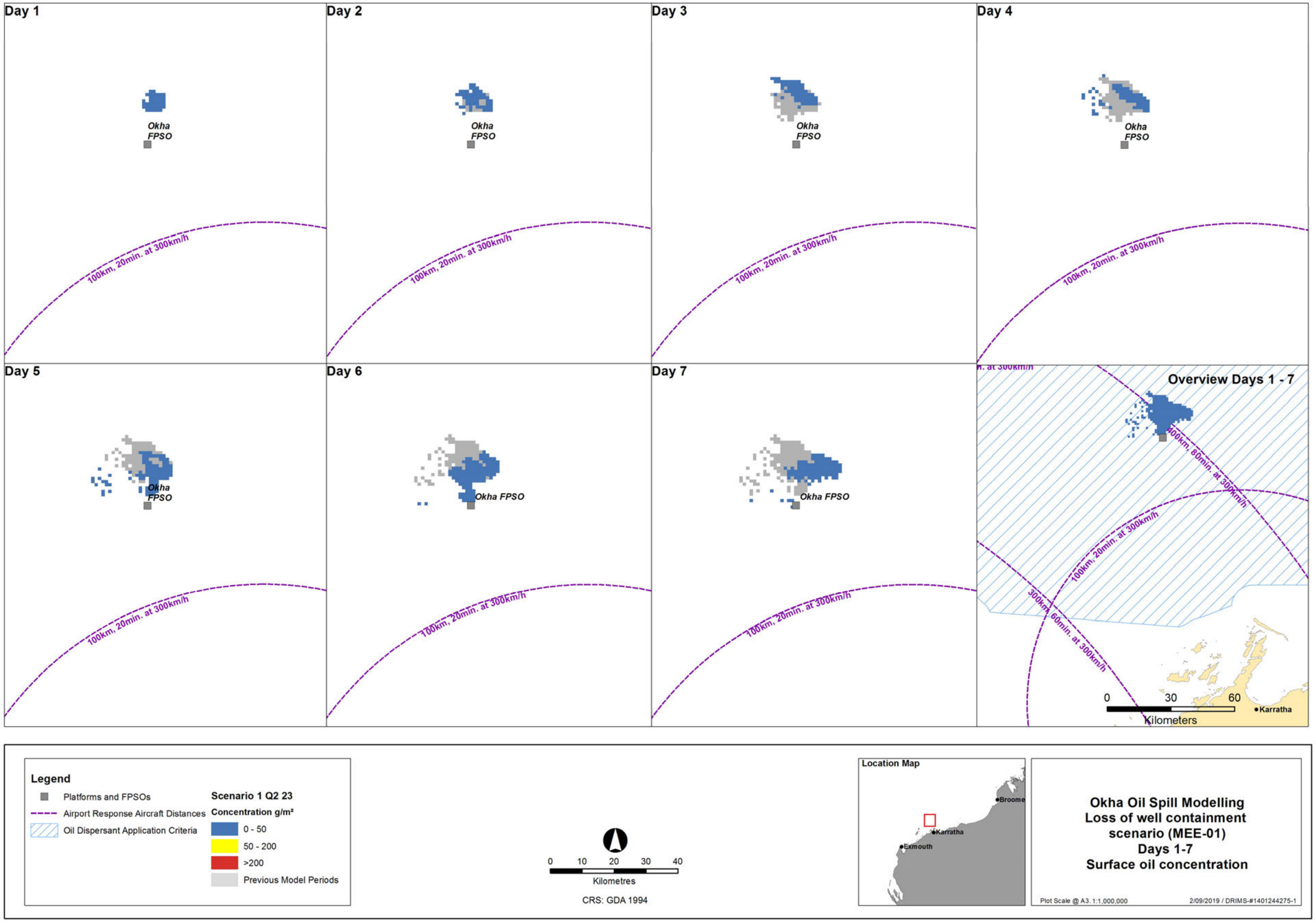

Figure 2-5: Okha FPSO Facility Operations loss of well containment (MEE-01) – Day 1-7 – Surface oil concentration

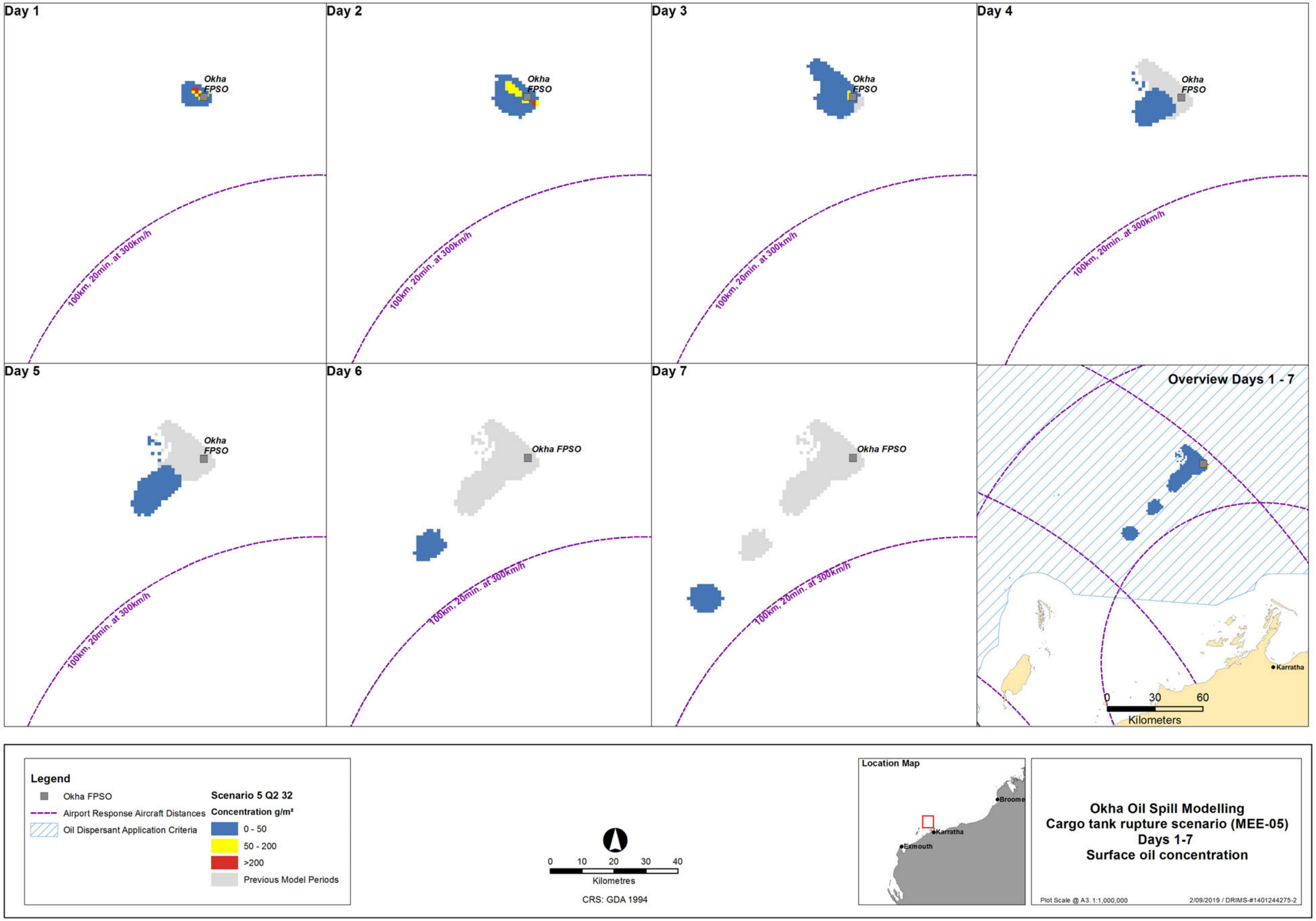

Figure 2-6: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Day 1-7 – Surface oil concentration

3 IDENTIFY RESPONSE PROTECTION AREAS

In a response, operational monitoring programs – including trajectory modelling and vessel/aerial observations – would be used to predict RPAs that may be impacted. For the purposes of planning and appropriately scaling a response, modelling has been used to identify RPAs as outlined below in Figure 3-1.

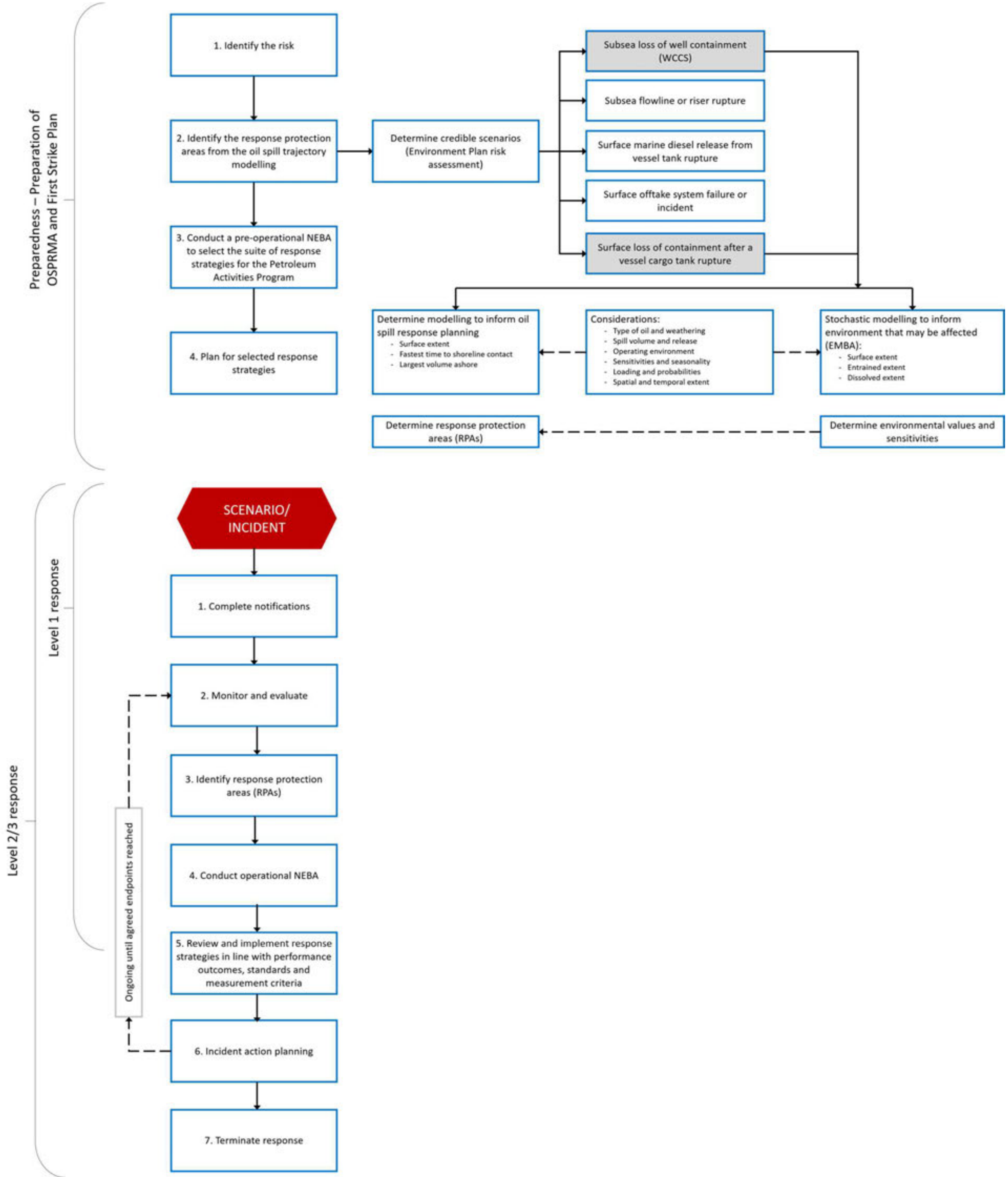

Figure 3-1: Identify Response Protection Areas (RPAs) flowchart

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)

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 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.

[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

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days [5]	Maximum shoreline accumulation (above 100g/m^2) in m^3 [6]	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3
			Scenario 1 (MEE-01) – Model 23, Q2		Scenario 5 (MEE-05) – Model 32, Q2	
Ningaloo Coast North and World Heritage Area	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	75 days (20 m^3)	30 m^3 (day 77)	40 days (0.3 m^3)	1.1 m^3 (day 44)
Montebello Islands and State Marine Park	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN II and IV – Recreational Use Zone IUCN II – Marine National Park Zone	No contact	No contact	11 days (71 m^3)	113 m^3 (day 14)
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	No contact	No contact	12 days (4 m^3)	63 m^3 (day 15)
Lowendal Islands	State Marine Park	IUCN VI – Multiple Use Zone	No contact	No contact	12 days (1 m^3)	3 m^3 (day 16)
Pi bara Islands – Southern Islands Group	State Marine Park Australian Marine Park	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	76 days (1.4 m^3)	66 m^3 (day 84)	19 days (0.7 m^3)	36 m^3 (day 40)

[5] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[6] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days (5)	Maximum shoreline accumulation (above 100g/m^2) in m^3 (6)	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3
			Scenario 1 (MEE-01) – Model 23, Q2		Scenario 5 (MEE-05) – Model 32, Q2	
Shark Bay World Heritage Area	State Marine Park Australian Marine Park World Heritage Area	N/A	99 days (0.2 m^3)	0.2 m^3 (99 days)	No contact	No contact
Exmouth Gulf West	N/A	N/A	83 days (0.08 m^3)	0.2 m^3 (87 days)	No contact	No contact
Muiron Islands Marine Management Area and World Heritage Area	Muiron Islands Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	75 days (0.3 m^3)	41 m^3 (99 days)	40 days (3 m^3)	4 m^3 (day 45)

4 NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

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.

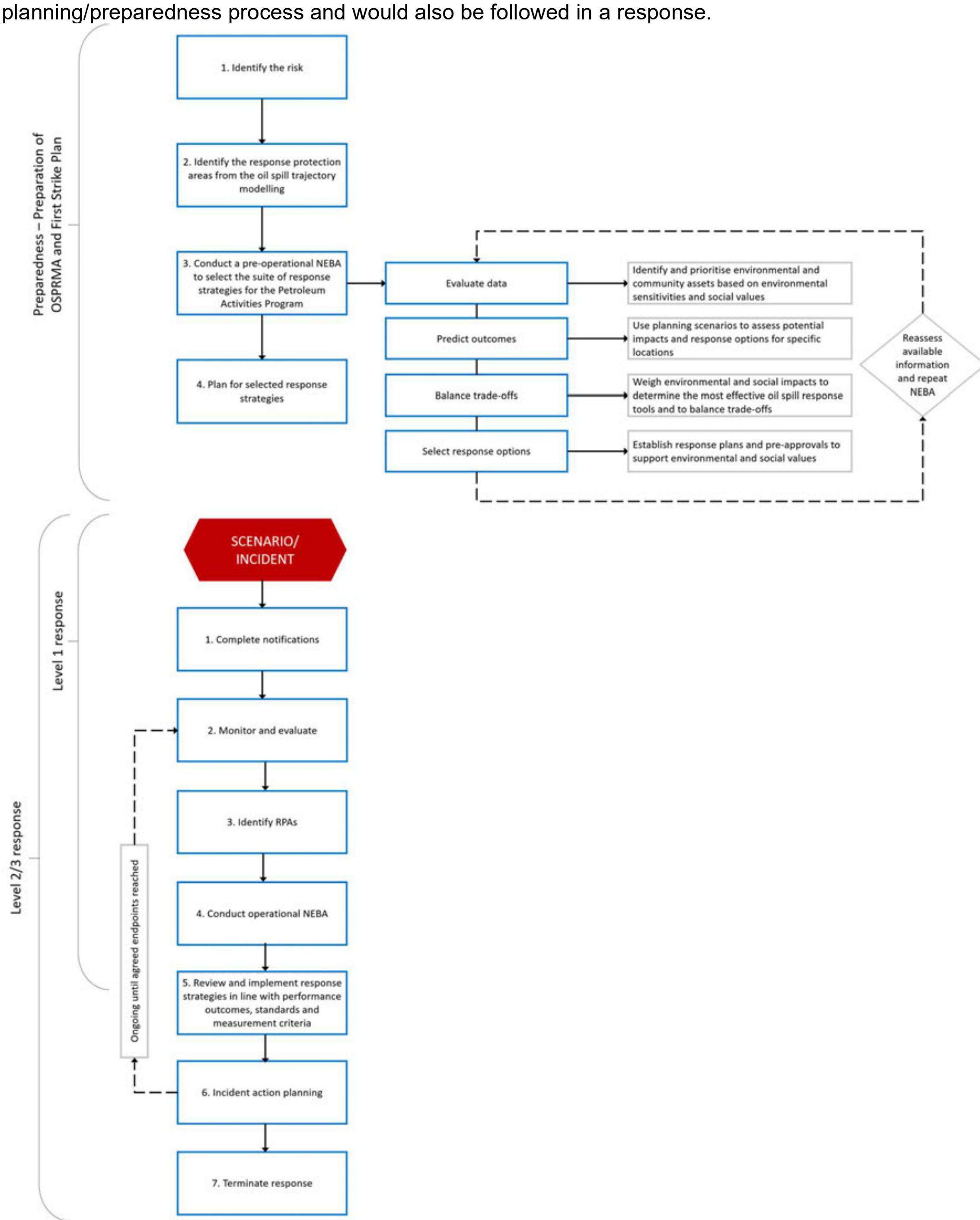

Figure 4-1: Net Environmental Benefit Analysis (NEBA) flowchart

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 through the use of trajectory modelling. Interpretation of stochastic oil spill modelling determines the EMBA for the release, which defines the spatial area that may be potentially impacted by the PAP activities.

4.2.1. Define the scenario(s)

Woodside uses scenarios identified from the risk assessment in the EP to assess potential impacts and response options for specific locations. The 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 – MEE-001)	
Scenario	Subsurface release after a loss of well control
Location	Lat: 19° 29' 58.47" S Long: 116° 29' 16.23" E
Oil Type	Cossack Light Crude
Fate and Weathering	52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C) 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C) 12.0% should evaporate over several days (265 °C < BP < 380 °C)
Volume and duration of release	185,945 m³ over 77 days
Scenario summary information (WCCS – MEE-003)	
Scenario	Surface release due to a support vessel tank rupture
Location	Lat: 19° 35' 21.00" S Long: 116° 26' 48.00" 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	105 m³ – instantaneous
Scenario summary information (WCCS – MEE-005)	
Scenario	Surface release after a rupture of a vessel cargo tank
Location	Lat: 19° 35' 21.00" S Long: 116° 26' 48.00" E
Oil Type	Cossack Light Crude
Fate and Weathering	52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C) 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C) 12.0% should evaporate over several days (265 °C < BP < 380 °C)
Volume and duration of release	30,302 m³ over 24 hours

4.2.1.1. Hydrocarbon characteristics

Cossack Light Crude (MEE-01 and MEE-05)

Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% 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.

Subsea release (MEE-01)

The results of the OILMAP simulation predict that the discharge will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of around 3 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 16 m.

The discharge velocity and turbulence generated by the expanding gas plume is predicted to generate oil droplets 840-3,040 µm in diameter. The droplet size calculation was based on a modified form of the OILMAP droplet algorithm that considers the influence of reservoir pressure. 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 reasonable buoyancy relative to other mixing processes, the droplets are likely to form floating slicks under calm wind conditions.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of response operations at or near the blowout site. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Diesel

Marine Diesel Oil is typically classed as an ITOPF Group I/II oil. It is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components.

Stochastic modelling results showed no shoreline contact at any threshold thus deterministic modelling was not undertaken. The response techniques that would be considered are monitor and evaluate, source control on the vessel (if feasible) and oiled wildlife response, if required.

Table 4-2: Oil fate, behaviour and impacts

Deterministic modelling results		
	MEE-01	**MEE-05**
Surface area of hydrocarbons (>50g/m^2 and <15,000cSt)	Surface hydrocarbons above threshold (>50 g/m^2 and <15,000 cSt) are predicted to be: • 3 km^2 (197 m^3) at Week 2 • Drop off to 0 km^2 (0 m^3) at Week 3 • 5 km^2 (347 m^3) by Week 4 • 15 km^2 (900 m^3) during Month 2 Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.	Surface hydrocarbons above threshold (>50 g/m^2 and <15,000 cSt) are predicted to be: • 9 km^2 (2,251 m^3) on Day 1 • 15 km^2 (1,633 m^3) on Day 2 Surface hydrocarbons return to 0 km^2 (0 m^3) on Day 3.
Minimum time to shoreline contact (above 100 g/m^2)	14 days (Barrow Island – 2 m^3)	7 days (Barrow Island – 42 m^3)
Largest volume ashore at any single RPA (above 100g/m^2)	66 m^3 (Pilbara Islands – Southern Islands Group – 84 days)	110 m^3 (Montebello Islands and Montebello Islands State Marine Park – 11 days)
Largest total shoreline accumulation (above 100g/m^2)	125 m^3 (Pilbara Islands – Southern Islands Group)	165 m^3 (Montebello Islands and Montebello Islands State Marine Park)

Response Protection Areas (RPAs)				
	MEE-01 (Model 23, Q2)		**MEE-05 (Model 32, Q2)**	
	Minimum time to shoreline contact (above 100g/m^2) in days	**Maximum shoreline accumulation (above 100g/m^2) in m^3**	**Minimum time to shoreline contact (above 100g/m^2) in days**	**Maximum shoreline accumulation (above 100g/m^2) in m^3**
Ningaloo Coast North and WHA	75 days (20 m^3)	30 m^3 (day 77)	40 days (0.3 m^3)	1.1 m^3 (day 44)
Montebello Islands and State Marine Park	No contact	No contact	11 days (71 m^3)	113 m^3 (day 14)
Barrow Island	No contact	No contact	12 days (4 m^3)	63 m^3 (day 15)
Lowendal Islands	No contact	No contact	12 days (1 m^3)	3 m^3 (day 16)
Pilbara Islands – Southern Islands Group	76 days (1.4 m^3)	66 m^3 (day 84)	19 days (0.7 m^3)	36 m^3 (day 40)
Shark Bay WHA	99 days (0.2 m^3)	0.2 m^3 (99 days)	No contact	No contact
Exmouth Gulf West	83 days (0.08 m^3)	0.2 m^3 (87 days)	No contact	No contact
Muiron Islands and MMA-WHA	75 days (0.3 m^3)	41 m^3 (99 days)	40 days (3 m^3)	4 m^3 (day 45)

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 and Table 4-5. These options are evaluated against each scenario's parameters including oil type, volume and characteristics, prevailing weather conditions, logistical support, and resource availability to determine their deployment feasibility.

A shortlist of the feasible response options is then carried forward for the ALARP assessment with a justification for the exclusion of other response techniques included in Section 4.2.3. This assessment will typically result in a range of available options, that are deployed at different areas (at-source, offshore, nearshore and onshore) and times through the response. The NEBA process assists in prioritising which options to use where and when and timings throughout the response.

Table 4-3: Response technique evaluation – Subsea Release (MEE-01)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Cossack Light 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 a Cossack Light 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 providing required information to regulatory agencies including AMSA and WA DoT.	**Yes**	Monitoring the spill will be necessary to: • validate trajectory and weathering models • determine the behaviour of the oil in water • determine the location and state of the slick • provide forecasts of spill trajectory • determine appropriate response techniques • determine effectiveness of response techniques • confirm impact pathways to receptors • provide regulatory agencies with required information.
Source control via Blowout Preventer (BOP) intervention using ROV and hotstab	N/A	N/A	**No**	N/A – Okha's LH3 well is a production well with no blowout preventer thus intervention and/or hotstab are not feasible response techniques.
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 subsea tree	**Yes**	Source control via ROV intervention using the 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 installation of subsea dispersant injection system.	Debris clearance is a feasible, and widely accepted and utilised technique.	**Yes**	Debris clearance will be a necessary procedure prior to installation of the subsea dispersant injection system, 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 Okha PAP has concluded that it is not a feasible response strategy. The subsea wells are comprised of vertical (VXT) subsea trees (Xmas tree). VXT have incompatible connector sizes and profiles (13 ⅝" connectors) with capping stacks (H4/HC 18 ¾" connector). Additionally, the well foundation may not have the required strength to carry the loads generated by a capping stack on top of VXT. In the case of damage to the tree, 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 Xmas tree 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.	**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 Cossack Light Crude will be over approximately 77 days. Relief well drilling will be the primary option to stop the release.	For a spill from the Okha FPSO Facility, 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 strategy.

Subsea Dispersant Injection (SSDI)	Application of subsea dispersant may reduce the scale and extent of hydrocarbons reaching the surface and thus reduce spill volumes contacting predicted RPAs. SSDI can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which may be otherwise unaffected. Entrained oil plume likely to be increased resulting in greater spatial extent of entrained oil.	Predicted to be feasible for the subsea hydrocarbon release due to properties of Cossack, Wanaea, Lambert, Hermes (CWLH) crudes upon which dispersant efficacy was undertaken – testing shows it is effective up to 65% weathering. Furthermore, SSDI could potentially be applied from outside the exclusion zone thus could be deployed even when there are high VOC levels at the spill source.	**Yes**	Potentially can treat large volumes of oil at source that could cause secondary contamination of wildlife or shorelines. Enhances biodegradation of hydrocarbons in water.
Surface dispersant application	Can potentially remove hydrocarbon from the surface preventing secondary contamination of wildlife or shorelines. Enhances biodegradation of hydrocarbons in water. Dispersant can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which may be otherwise unaffected. Entrained oil plume likely to be increased resulting in greater spatial extent of entrained oil.	Appropriate surface concentration for surface dispersant application is present (50 g/m^2). Predicted to be feasible for surfacing hydrocarbon from the subsea release due to CWLH crude properties – dispersant efficacy testing shows it is effective up to 65% weathering. Safety of response personnel must be ensured before deployment.	**Yes**	In the event that SSDI cannot be employed, surface dispersant would provide the next greatest reduction in surface hydrocarbon availability. This reduces potential impacts to shorelines and wildlife.
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 strategy is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the strategy is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. Volatile nature of the oil 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 strategy is unsuitable for the Okha activity.
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.	Appropriate surface concentration for containment and recovery is present. Predicted low effectiveness – typical expectation is less than 10% of hydrocarbon released can be contained and recovered. Deepwater Horizon/Macondo was approx. 3–5% with the largest containment and recovery operation ever conducted. Meteorological conditions and sea-state must allow the deployment of booms and skimmers. Surface hydrocarbon would need to be corralled to a sufficient thickness to permit efficient recovery by skimmers. Volatile nature of the hydrocarbon likely to lead to unsafe conditions near release location.	**Yes**	Potential to slightly reduce the magnitude, probability of, extent of, contact with and accumulation on shorelines receptors if and when appropriate encounter rates can be achieved and in conditions that are safe for response personnel.
Shoreline Protection and Deflection	Shoreline protection and deflection can be effective at preventing contamination of sensitive resources and can be used to corral oil into slicks thick enough to skim effectively.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate surface hydrocarbons are moving toward shorelines, pre-emptive assessments of sensitive receptors at risk (OM04) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills). For MEE-01, first shoreline contact is predicted from floating surface hydrocarbon on Day 14 (2 m^3 at Barrow Island) allowing adequate time to deploy this technique. Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	**Yes**	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 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.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate hydrocarbons will contact shorelines, pre-emptive assessments of sensitive receptors at risk (OM04), shoreline assessments (OM05) and existing TRPs will be utilised, in agreement with WA DoT (for Level 2/3 spills), to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. For MEE-01, first shoreline contact is predicted from floating surface hydrocarbon on Day 14 (2 m^3 at Barrow Island) allowing adequate time to deploy this technique. Can reduce or prevent impact on sensitive receptors in most cases. Must ensure, through shoreline assessment, that sensitive sites will benefit from clean-up activities as the response itself may cause more negative impact than benefit through disturbance of habitats and species.	Yes	Response Protection Areas predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are at risk, based on real-time modelling during a spill event, shoreline clean-up techniques will be deployed to expedite clean-up of the impacted sites. Removal of hydrocarbons will help shorten the recovery window unless shoreline type is of a sensitive nature. This technique can help prevent remobilisation of hydrocarbon and impact on shorelines.
Oiled Wildlife Response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is achieved through rehabilitation of fauna already subject to contamination and also through pre-emptive capture/hazing to prevent additional fauna 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 – Hydrocarbon release of due to a Support Vessel Tank Rupture (MEE-03)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Marine Diesel				
Monitor and Evaluate	Will be effective in tracking the location of the spill, predicting potential impacts and triggering further monitoring and response techniques as required. Monitoring techniques include: • OM01 Predictive modelling of hydrocarbons – used throughout spill. 'Ground-truthed' using the outputs of all other monitoring techniques. • OM02 Surveillance and reconnaissance to detect hydrocarbons and resources at risk – from outset of spill. • OM03 Monitoring of hydrocarbon presence, properties, behaviour and weathering in water – from outset of spill. • OM04 Pre-emptive assessment of sensitive receptors at risk – triggered once OM01, OM02 and OM03 inform likely RPAs at risk. • OM05 Shoreline assessment – once OM02, OM03 and OM04 inform 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. Practicable techniques that could be used for this scenario include predictive modelling (OM01), surveillance and reconnaissance OM02), monitoring of hydrocarbon presence in water (OM03). Due to the fact that modelling predicts no shoreline impacts at any threshold, pre-emptive assessment of sensitive receptors at risk (OM04) and monitoring of contaminated resources (OM05) are unlikely to be required.	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 non-persistent and 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.
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 non-persistent, prone to rapid spreading and evaporation, and does not tend to form emulsions 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.
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 and evaporation. 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.
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.	**No**	In addition to the rapid spreading and evaporation of the diesel, the modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at any of the assessed thresholds.
Shoreline Clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	Modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at any of the assessed thresholds.	**No**	Modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at any of the assessed thresholds and a spill of marine diesel is unlikely to accumulate at concentrations appropriate for shoreline clean-up techniques.
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 fauna from being contaminated and through rehabilitation of fauna 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 fauna are at risk of contamination, oiled wildlife response will be undertaken as and where required.

Table 4-5: Response technique evaluation – Hydrocarbon release caused by a vessel cargo tank rupture (MEE-05)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Cossack Light 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 a Cossack Light 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 providing required information to regulatory agencies including AMSA and WA DoT.	**Yes**	Monitoring the spill will be necessary to: • validate trajectory and weathering models. • determine the behaviour of the oil in water. • determine the location and state of the slick. • provide forecasts of spill trajectory. • determine appropriate response techniques. • determine effectiveness of response techniques. • confirm impact pathways to receptors. • provide regulatory agencies with required information.
Source Control (vessel)	Controlling a cargo tank spill at source would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	Source control will be limited to what the vessel or facility can achieve during the spill duration (24 hours) whilst simultaneously 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	Can potentially remove hydrocarbon from the surface preventing secondary contamination of wildlife or shorelines. Enhances biodegradation of hydrocarbons in water. Dispersant can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons.	Appropriate surface concentration for surface dispersant application is present (50 g/m^2). Predicted to be feasible for the surface hydrocarbon release due to CWLH crude properties – dispersant efficacy testing shows it is effective up to 65% weathering. Safety of response personnel must be ensured before deployment.	**Yes**	Surface dispersant can provide the greatest reduction in surface hydrocarbon availability offshore. This reduces potential impacts to shorelines and wildlife.

	Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which may be otherwise unaffected. Entrained oil plume likely to be increased resulting in greater spatial extent of entrained oil.			
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 strategy is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the strategy is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. Volatile nature of the oil 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 strategy is unsuitable for the Okha activity.
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. It also has the potential to reduce the magnitude and extent of contact with submerged receptors by entrained/ dissolved hydrocarbons. 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.	Appropriate surface concentration for containment and recovery is present. Meteorological conditions and sea-state must allow the safe 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.	Yes	Potential to slightly reduce the magnitude, probability of, extent of, contact with and accumulation on shorelines receptors if and when appropriate encounter rates can be achieved and in conditions that are safe for response personnel.
Shoreline Protection and Deflection	Shoreline protection and deflection can be effective at preventing contamination of sensitive resources and can be used to corral oil into slicks thick enough to skim effectively.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate surface hydrocarbons are moving toward shorelines, pre-emptive assessments of sensitive receptors at risk (OM04) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills). For MEE-05, first shoreline contact is predicted from floating surface hydrocarbon on Day 7 (42 m^3 at Barrow Island) allowing adequate time to deploy this technique. Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	Yes	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 deemed to be at risk, based on real-time modelling during a spill event, shoreline protection and deflection techniques will be employed to minimise hydrocarbon contact providing net environmental benefit.
Shoreline Clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate hydrocarbons will contact shorelines, pre-emptive assessments of sensitive receptors at risk (OM04), shoreline assessments (OM05) and existing TRPs will be utilised, in agreement with WA DoT (for Level 2/3 spills), to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. For MEE-05, first shoreline contact is predicted from floating surface hydrocarbon on Day 7 (42 m^3 at Barrow Island) allowing adequate time to deploy this technique. Can reduce or prevent impact on sensitive receptors in most cases. Must ensure, through shoreline assessment, that sensitive sites will benefit from clean-up activities as the response itself may cause more negative impact than benefit through disturbance of habitats and species.	Yes	Response Protection Areas predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are at risk, based on real-time modelling during a spill event, shoreline clean-up techniques will be deployed to expedite clean-up of the impacted sites. Removal of hydrocarbons will help shorten the recovery window unless shoreline type is of a sensitive nature. This technique can help prevent remobilisation of hydrocarbon and impact on shorelines.
Oiled Wildlife Response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is achieved through rehabilitation of fauna already subject to contamination and also through hazing to prevent additional fauna 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.

4.2.3. Exclusion of response techniques

4.2.3.1. Source control via Blowout Preventer (BOP) intervention using ROV and hotstab

Okha's LH3 well is a production well with no blowout preventer thus intervention and/or hotstab are not feasible response techniques.

4.2.3.2. Source control via capping stack deployment

Evaluation of the viability of utilising a capping stack for the Okha PAP has concluded that it is not a feasible response strategy because they are vertical subsea trees (VXT). VXT have incompatible connector sizes and profiles (13 ⅝" connectors) with capping stacks (H4/HC 18 ¾" connector). Additionally, the well foundation may not have the required strength to carry the loads generated by a capping stack on top of a VXT.

In the case of damage to the tree, 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 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.

4.2.3.3. 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.

4.2.3.4. In-situ burning

This technique requires calm sea state conditions as is required for containment and recovery operations, which limits its feasibility on the Northwest shelf. Optimum weather conditions are <20 knot wind speed and waves <1 to 1.5 m with oil collected to a minimum 3mm thick layer. Due to the conditions in the region, it is expected that the ability to contain oil may be limited as the sea state may exceed the optimum conditions. The window of opportunity for this technique is also limited by the need for very fresh, non-weathered hydrocarbon in order to maximise burn efficiency and reduce residue thickness.

There are health and safety risks for response personnel associated with the containment and subsequent burning of hydrocarbons. It is also suggested that the residue from attempts to burn would sink, thereby posing a risk to the environment. The longer-term effects of burn residues on the marine environment are not fully understood and therefore, no assessment of the potential environmental impact can be determined.

Until further operational and environmental information becomes available, Woodside will not consider this option.

4.3. Stage 2: Predict outcomes

Woodside uses planning scenarios to assess potential impacts and response options for specific locations. Locations with potential environmental impacts, selected from the stochastic modelling are included for assessment. Response thresholds and deterministic modelling are then used to assess the feasibility/effectiveness of a response.

4.4. Stage 3: Balance trade-offs

Woodside considers environmental impacts and response effectiveness/feasibility to determine the most effective oil spill response tools and balance trade-offs, using an automated NEBA tool. The tool considers potential benefits and impacts associated with a response at sensitive receptors and then considers the effectiveness/feasibility of the response to select the response techniques carried forward to the ALARP assessment. 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 6.10.

Table 4-6: Selection and prioritisation of response techniques

		Feasibility of response techniques														Outline response technique
Response planning scenario	Key characteristics for response planning (times are minimum times to contact for first receptor and/or shoreline contacted above response threshold)	Monitor and evaluate	Source control – well control package via ROV or subsea tree	Debris clearance – for subsea dispersant	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	
MEE-01: Hydrocarbon release caused by loss of well containment. 185,915 m^3 of Cossack Light Crude released over 77 days (residual component of 28,445 m^3)	Fastest time to shoreline accumulation >100 g/m^2: Barrow Island 14 days (2 m^3) Largest shoreline accumulation: Pilbara Islands – Southern Islands Group 66 m^3 (43 days)	Yes	Yes	Yes	No	N/A	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Monitor and evaluate. Initiate relief well drilling. Initiate subsea dispersant injection. Initiate surface dispersant application. Consider Containment and Recovery viability and implement if NEB 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.
MEE-03: Instantaneous surface release of 105 m^3 marine diesel from a support vessel (5% residual component of 5.25 m^3)	No shoreline contact predicted at any modelled threshold	Yes	N/A	N/A	N/A	Yes	N/A	N/A	No	No	No	No	No	No	Yes	Monitor and evaluate. Initiate source control if feasible. Plan for oiled wildlife response and implement if oiled wildlife is observed.
MEE-05: Hydrocarbon release caused by a vessel cargo tank rupture. 30,302 m^3 of Cossack Light Crude released over 24 hours (residual component of 4,636 m^3)	Fastest time to shoreline accumulation >100 g/m^2: Barrow Island 7 days (42 m^3) Largest shoreline accumulation: Montebello Islands and Montebello Islands State Marine 110 m^3 (11 days)	Yes	N/A	N/A	N/A	Yes	N/A	N/A	Yes	No	No	Yes	Yes	Yes	Yes	Monitor and evaluate. Initiate source control if feasible. Initiate surface dispersant application. Consider Containment and Recovery viability and implement if NEB 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.

From the NEBA undertaken on the WCCSs identified (loss of well containment – MEE-01, marine diesel from a support vessel – MEE-03 and vessel cargo tank rupture – MEE-05), the recommended response techniques are;

- Monitor and evaluate (all scenarios)
- Source control – via ROV and subsea tree (MEE-01)
- Source control via relief well drilling (MEE-01)
- Source control on the vessel (MEE-03 and MEE-05)
- Debris clearance for subsea dispersant injection (MEE-01)

- Subsea dispersant injection (MEE-01)
- Surface dispersant application (MEE-01 and MEE-05)
- Containment and recovery (MEE-01 and MEE-05)
- Shoreline protection and deflection at identified RPAs (MEE-01 and MEE-05)
- Shoreline clean-up on priority impacted coastlines (MEE-01 and MEE-05)
- 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 'Woodside Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) Guidelines'.

From the identified response planning need and pre-operational NEBA, Woodside conducts a structured, semi-quantitative hydrocarbon spill process which has the following steps:

1. considers the Response Planning Need identified in terms of surface area (km^2) and available surface hydrocarbon volumes (m^3) against existing Woodside capability
2. considers alternative, additional, and improved options for each response technique/control measure by providing an initial and, if required, detailed evaluation of:
   - predicted cost associated with adopting the control measure
   - predicted change/environmental benefit
   - predicted effectiveness/feasibility of the control measure.
3. evaluates the risks and impacts of implementing the proposed response techniques, and any further control measures with associated environmental performance to manage these additional risks and impacts.

Woodside considers the risks and impacts from a hydrocarbon spill to have been reduced to ALARP when:

1. a structured process for identifying and considering alternative, additional, and improved options has been completed for each selected response technique
2. the analysis of alternate, additional, and improved control measures meets one of the following criteria:
   - all identified, reasonably practicable control measures have been adopted
   - no identified reasonably practicable additional, alternative and/or improved control measures would provide further overall increased proportionate environmental benefit; or
   - no reasonably practical additional, alternative, and/or improved control measures have been identified.
3. where an alternative, additional and/or improved control measure is adopted, a measurable level of environmental performance has been assigned
4. higher order impacts/ risks have received more comprehensive alternative, additional, and improved control measure evaluations and do not just compare the cost of the adopted control measures to the costs of an extreme or clearly unreasonable control measure
5. cumulative effects have been analysed when considered in combination across the whole activity.

The response technique selection is based on the risk assessment conducted in the EP. The risk assessment identifies the type of oil, volume of release, duration of release, predicted fate, weathering and the EMBA (along with other requirements such as time to impact and predicted volumes ashore). Modelling is then used to inform the NEBA and the prioritisation of suitable response options. The scale of the response techniques selected in the pre-operational NEBA is informed through the assessment of results from deterministic modelling.

For the purpose of the ALARP assessment, the following terms and definitions have been used:

- Response techniques are considered the control measures that reduce consequences from hydrocarbon spill events. The terms 'response technique' and 'control measure' are used interchangeably.

- Cost is defined as the time, effort and/or trouble taken in financial, safety, design/storage/installation, capital/lease, and/or operations/maintenance terms to adopt a control measure.
- Where the predicted change to environmental impact is compared against standard environmental values and sensitivities impacts using positive or negative criteria from the NEBA Impact Ranking Classification Guidance in ANNEX A.

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 Dampier, Karratha, Port Hedland, Exmouth and Onslow to the spill event location means that multiple logistical options are available to monitor the spill in relatively short timeframes. The primary mobilisation base for initial monitoring activities would be Dampier, however, in the event of an extended spill with potential to impact receptors further afield, monitoring activities may also be mobilised from Onslow, Port Hedland and Exmouth.

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 7 days (42 m^3, vessel cargo tank rupture scenario – MEE-05) and 14 days (2 m^3, loss of well containment scenario – MEE-01).
- The time to contact for oil at concentrations of entrained hydrocarbons greater than 500 ppb at shoreline receptors is 5.7 days at Montebello Islands (2,564 ppb, vessel cargo tank rupture scenario – MEE-05) and 9.1 days at Montebello Islands (515 ppb, loss of well containment scenario – MEE-01).
- 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 Month 4 (MEE-01) 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 (see Section 5.12)**
1	Oil spill trajectory modelling	1.1	Initial modelling available within 6 hours using the Rapid Assessment Tool	1, 3B, 3C, 4
		1.2	Detailed modelling available within 4 hours of APASA receiving information from Woodside	
		1.3	Detailed modelling service available for the duration of the incident upon contract activation	
2	Tracking buoy	2.1	Tracking buoy located on facility/vessel and ready for deployment 24/7	1, 3A, 3C, 4
		2.2	Deploy tracking buoy from facility within 2 hours as per the first strike plan.	1, 3A, 3B, 4
		2.3	Contract in place with service provider to allow data from tracking buoy to be received 24/7 and processed.	1, 3B, 3C, 4
		2.4	Data received to be uploaded into Woodside COP daily to improve the accuracy of other monitor and evaluate 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 Clean-up Assessment Technique (SCAT), containment and recovery and surface dispersal and pre-emptive assessments as contingency if required.	1, 2
5	Hydrocarbon detections in water	5.1	Activate 3rd party service provider as per first strike plan. Deploy resources within 3 days: • 3 specialists in water quality monitoring • 2 monitoring systems and ancillaries • 1 vessel for deploying the monitoring systems with a dedicated winch, A-frame or Hiab and ancillaries to deploy the equipment.	1, 2, 3C, 3D, 4
		5.2	Water monitoring services available and employed during response	1, 3C, 4
		5.3	Preliminary results of water sample as per contractor's implementation plan within 7 days of receipt of samples at the accredited lab	
		5.4	Daily fluorometry reports as per service provider's implementation plan will be provided to IMT to validate modelling and monitor presence/absence of entrained hydrocarbons.	

		5.5	Use of Autonomous Underwater Vehicles (AUVs) for hydrocarbon presence and detection may be used as a contingency if the 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 1 specialist(s) in SCAT from resource pool for each of the Response Protection Areas (RPAs) with predicted impacts.	1, 2, 3B, 3C, 4
		7.2	SCAT reports provided to IMT daily detailing the assessed areas to maximise effective utilisation of resources	1, 3B, 4
		7.3	Shoreline access routes with the least environmental impact identified will be selected by a specialist in SCAT operations	1

The control measures and capability of Woodside and its third-party service providers are shown to support Monitor and Evaluate activities up to and including the identified WCCS. This is demonstrated by the following:

- Woodside has a documented, structured and tested capability for Monitor and Evaluate operations including internal trajectory modelling capabilities, tracking buoys located offshore and contracted aerial observation platforms with access to trained observers.
- Woodside and its third-party service providers ensure there is sufficient capability for the duration of the response.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.
- 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 via Relief Well Drilling

The worst-case scenario identified for the petroleum activity program is considered to be a loss of well containment from LH3 well (MEE-01). This well has a vertical Xmas tree 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, some existing barriers may remain active.

The Woodside Source Control Response Procedure includes the process for the IMT to mobilise resources for Subsea First Response Toolkit (SFRT) support. This plan has pre-identified vessel specifications and contracts required for SFRT debris clearance work and Woodside monitors the availability and location of these vessels.

Woodside is a signatory to 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 loss of well containment incident were to occur. The MOU commits the signatories to share rigs, equipment, personnel and services to assist another operator in need. Dynamically positioned and most jack up rigs are not suitable for the Okha FPSO water depth, therefore a moored MODU would be required.

Source control operations cannot be implemented if the safety of response personnel cannot be guaranteed. Circumstances that limit the safe execution of this control measure include 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 up to Month 4 (MEE-01) 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

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 Okha FPSO Facility and its 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 – 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 (see Section 5.12)**
8	Subsea First Response Toolkit (SFRT)	8.1	Oceaneering support staff available all year round, via contract, to assist with the mobilisation, deployment, and operation of the SFRT equipment.	1, 3B, 3C
		8.2	Intervention vessel with minimum requirement of a working class ROV and operator.	1, 3C
		8.3	Mobilised to site for deployment within 11 days.	1, 3B, 3C
		8.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
9	Well intervention	9.1	Frame agreements with ROV providers in place to be mobilised upon notification. ROV equipment deployed within 7 days.	1, 3B, 3C
		9.2	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 provide a feasible and viable approach to relief well drilling operations to stop the well flowing.

- The health and safety, financial, capital and operations/maintenance costs of implementing the alternative, additional or improved control measures identified and not carried forward are considered clearly disproportionate to the insignificant environmental benefit gained and/or not reasonably practicable for this PAP.

- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.2.

5.3. Subsea Dispersant Injection

Subsea dispersant injection involves the deployment of a subsea dispersant manifold with associated equipment to inject chemical dispersant directly into the oil plume in the event of a loss of well containment. 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.

5.3.1. Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- The maximum volume of subsea hydrocarbons released is predicted to be approximately 2,414 m^3/day for 11 weeks/ Day 77 day when 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 up to Month 4 (MEE-01) 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		
Technique	**Predicted performance range**[7] (% of oil volume predicted to be treated by response technique)	
Subsea Dispersant Injection	Lower	1:100 DOR (used to determine the volume of dispersant required)
	Upper	1:50 DOR (used to determine the volume of dispersant required)
	The predicted performance range for SSDI is based on; • Total rate of released oil available for SSDI. • Subsea inspection (ROV) observing oil release and technique safe for deployment. • Dispersant to oil application at 1:50-1:100. • Predicted dispersant effectiveness of 50-60% of contacted subsea oil.	

[7] 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.

SSDI operation	• 1 x SSDI operation includes: – 1 x suitable ISV (vessel specifications as per SFRT and Capping Stack Mobilisation 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
Dispersant Effectiveness	Average subsea dispersant efficacy, based upon industry research, is: • Lower – 50% • Upper – 60%

5.3.2. 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 (see Section 5.12)**
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	Monthly 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 maximum volume of subsea hydrocarbons released is predicted to be approximately 2,414 m^3/day for 11 weeks/ 77 days when the well is killed.

Dispersant efficacy testing has not been undertaken for subsea conditions, but industry experience estimates a subsea amenability to dispersant of approximately 50-60% effectiveness.

The SSDI capability currently available provides the capacity to treat 1,800-4,500 m^3 of subsea hydrocarbons per day with the application of 60-75m^3/day of dispersant. The release rates for Okha FPSO Facility Operations LH3 well is 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):

- Entrained hydrocarbon concentrations in the water column are predicted to increase at most subsurface receptor locations, with dispersant application from the trapping of treated entrained hydrocarbons at a lower depth (from subsea dispersant application) due to the greatly reduced droplet size and therefore reduced buoyancy.

- The application of subsea dispersant may reduce the maximum local concentrations and maximum accumulated volumes at receptors predicted to be contacted by floating hydrocarbons and may reduce the amount of hydrocarbons reaching the shoreline.
- The scope of the Frame Agreement Vessel Safety Case includes a range of subsea activities that would cover the requirement for SSDI operations such as subsea manifold installation, commissioning, cargo transfer (including bulk liquids), operating as a stable platform for activities including ROV operations, and accommodation support alongside or within the 500m safety zone of an existing facility which may be in production.
- An SSDI vessel can be activated and mobilised within 12 days. Detailed breakdown of this timing is included in Section 6.2.5.1. 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 6.2.5.1.

5.4. Surface Dispersant Application

Surface dispersant application may reduce surface hydrocarbons and therefore prevent, or reduce the scale of, shoreline contact. Priority would be placed on treating high volume surface hydrocarbons closest to the release location as this is where high surface concentrations are predicted, and dispersant application is expected to achieve the greatest environmental benefit (refer to ANNEX A: Net Environmental Benefit Analysis detailed outcomes).

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.

5.4.1. Response need based on predicted consequence parameters

Okha FPSO Facility Operations loss of well containment (MEE-01)

The following statements identify the key parameters upon which response need is based for each scenario:

- Based on deterministic modelling, surface hydrocarbons within threshold concentration (>50g/m^2) and viscosity parameters (<15,000 cSt) available for surface dispersant application are predicted to be:
  - 197 m^3 in Week 2
  - 0 m^3 in Week 3
  - 347 m^3 in Week 4
  - 900 m^3 during Month 2
  - 0 m^3 thereafter
- Surface volume peaks at 900 m^3 in Month 2 and surface area peaks at 15 km^2 in Month 2.
- The duration of the spill may extend up to 77 days with response operations extending up to Month 4 (MEE-01) based on the predicted time to complete shoreline clean-up operations.

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)

The following statements identify the key parameters upon which response need is based:

- Based on deterministic modelling, surface hydrocarbons within threshold concentration (>50g/m^2) and viscosity parameters (<15,000 cSt) available for surface dispersant application are predicted to be:
  - 2,251 m^3 on Day 1
  - 1,633 m^3 on Day 2
  - 0 m^3 (at threshold concentration) on Day 3.
- Surface volume peaks at 2,251 m^3 on Day and surface area peaks at 15 km^2 on Day 2.
- The duration of the spill may extend up to 24 hours with response operations extending to 2 months based on the predicted time to complete shoreline clean-up operations.

All scenarios

- Arrangements for support organisations who provide specialist services (dispersant spray aircraft, logistics services for mobilising dispersant and Air Attack Supervisors) or resources (dispersants and transfer pumping systems) and should be tested regularly.
- Plans, procedures and support documents are in place for Operational and Support functions. These should be reviewed and updated regularly.
- Defined Zone of Application (ZoA) to reduce environmental consequences on subsea receptors.

In addition, a number of assumptions are required to estimate the response need for Surface Dispersant Application. These assumptions have been described in the table below.

Table 5-7: Response Planning Assumptions – Surface Dispersant Application

Response Planning Assumptions		
Technique	**Predicted performance range**[8] (% of surface oil volume available predicted to be treated by response technique)	
Surface Dispersant Application (Combined vessel and aircraft)	Lower	2% (1:25 DOR x 16% effectiveness x 50% encounter rate)
	Upper	12% (1:20 DOR x 84% effectiveness x 75% encounter rate)
	The predicted performance range for surface dispersant application (SDA) is based on; • Remaining surface oil available for SDA 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 100g/m² and 50 litres/hectare application rate) allows for 3-4 km² per aircraft per day. • Predicted dispersant effectiveness of 16-84% for contacted surface oil. • Spraying encounter rate of approximately 50-75% (50-25% of dispersant sprayed does not contact surface oil). •	
Physical properties	**Surface Threshold** • Lower – 50g/m² (equates to 100g/m² with approx. 50% coverage and/or 200g/m² with approx. 25% coverage) – BAOAC 4 – Discontinuous true oil colour - lower threshold 50g/m² • Optimum – 100g/m² (equates to >100g/m² with approx. 100% coverage and/or 200g/m² with approx. 50% coverage) – BAOAC 5 – Continuous true oil colour – lower threshold 200 g/m² **Viscosity** • Optimum – <5,000 cSt at sea surface temperature • Upper – 15,000 cSt at sea surface temperature	
Dispersant Effectiveness	Dispersant testing on Cossack Light Crude indicates that average dispersant efficiency (%) for oil age will be; • ~45% (0 hours) • ~84% (<12 hrs) • ~16% (48-96 hrs) This data is based on a range of weathering results and five National Plan OSCA approved and/or transitional dispersants that will be the most likely dispersants used by Woodside.	

[8] Performance ranges outlined above are indicative for response planning purposes. Where actual figures and concentrations exist based on deterministic modelling or laboratory results, these will be used for response and capability planning.

5.4.2. Environmental performance based on need

Table 5-8: Environmental Performance - Surface Dispersant Application

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors and increase the bioavailability of hydrocarbons for microbial breakdown.		
Control measure		**Performance Standard**		**Measurement Criteria (see Section 5.12)**
15	Aerial spraying	15.1	One aircraft with minimum payload of 1,850 litre mobilised to site within 4 hours of activation. One additional aircraft mobilised to site within another 20 hours of activation. Four additional aircraft mobilised to site within 48 hours of activation.	1, 3B, 3C, 4
		15.2	One high capacity aircraft with minimum payload of 10m³ 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	Two 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	Two 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
17	Dispersant	17.1	Year-round access to 5,000m³ 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 and surface release scenario.

- Surface concentration, viscosity and mass vary for each time step based on spreading and weathering algorithms from the deterministic modelling results. Woodside has reviewed the deterministic modelling data based to determine the Response Need and required capability for surface dispersant application as a response technique.
- **Okha FPSO Facility Operations loss of well containment (MEE-01)** – Deterministic modelling predicts that surface hydrocarbon volume peaks at 900 m³ in Month 2 (and surface area peaks at 15 km² in Month 2) for vessel and aerial dispersant operations to treat at threshold concentration. Woodside's existing capability is sufficient to treat the expected surface hydrocarbons throughout the incident.
- **Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)** – Deterministic modelling predicts that surface hydrocarbon volume peaks at 2,250 m³ on Day 1 (and surface area peaks at 15 km² on Day 2) for vessel and aerial dispersant operations to treat at threshold concentration. Woodside's existing capability is sufficient to treat the expected surface hydrocarbons throughout the incident.

- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.4.
- No further control measures that may result in an increased environmental benefit that involve moderate to significant cost and/or dedication of resources have been adopted as the limited scale and timeframe for deployment of this technique does not justify the excessive costs of identified alternate, improved or additional controls.

5.5. Containment and Recovery

Containment and recovery is used to reduce damage to sensitive resources by the physical containment and mechanical removal of hydrocarbons from the marine environment. It has a lower capacity for removing surface oil than the application of dispersant but avoids potential additional impacts created by the resulting increase in entrained hydrocarbons in the water column.

Weathering and spreading of hydrocarbons will significantly reduce containment and recovery effectiveness. In the event of an ongoing loss of well control, modelling predicts fresh hydrocarbons reaching the surface may be heavily weathered and present in small discrete patches. Containment and recovery is also weather and sea–state dependent. Periods of downtime can be expected.

The average annual conditions in the vicinity of the Okha FPSO are expected to be Beaufort Sea-state 3-4 (wind speed 4.7 m/s to 7.5 m/s) with maximum windspeeds of Beaufort Sea-state 6-10 (wind speed 12.4 m/s to 25.5 m/s) (RPS, 2019). It is, therefore, expected that open water containment and recovery operations would not, in general, be an effective response technique. However, containment and recovery may be available for deployment nearshore and/or when the weather window permits, and priority would be given to being prepared to deploy units if the required conditions are met.

The *Containment and Recovery Operational Plan* details the mobilisation and resource requirements for response operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

5.5.1. Response need based on predicted consequence parameters

Okha FPSO Facility Operations loss of well containment (MEE-01)

The following statements identify the key parameters upon which response need is based:

- Based on deterministic modelling, surface hydrocarbons above threshold concentration (>50g/m^2) available for containment and recovery are predicted to be:
  - 197 m^3 in Week 2
  - 0 m^3 in Week 3
  - 347 m^3 in Week 4
  - 900 m^3 during Month 2
  - 0 m^3 thereafter
- Surface volume peaks at 877 m^3 on Day 58, surface area peaks at 3 km^2 on Day 48.
- The duration of the spill may be up to 77 days with offshore response operations extending from Week 2 to Month 2 (at times when surface hydrocarbons are at recoverable threshold concentrations) and shoreline response operations extending up to Month 4 based on the predicted time to complete shoreline clean-up operations.

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)

The following statements identify the key parameters upon which response need is based:

- Surface hydrocarbons above threshold concentration (>50 g/m^2) available for containment and recovery are predicted to be 2,250 m^3 on Day 1 and 1,633 m^3 on Day 2 based on the deterministic modelling.
- Surface volume peaks at 2,250 m^3 on Day 1 and surface area peaks at 15 km^2 on Day 2.
- The duration of the spill may be up to 24 hours with offshore response operations extending to 2 days (when surface hydrocarbons fall below recoverable threshold concentrations) and shoreline response operations extending to Month 2 based on the predicted time to complete shoreline clean-up operations.

All scenarios

- 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

Response Planning Assumptions		
Technique	**Predicted performance range** (% of surface oil volume available predicted to be recovered by response technique)	
Containment and recovery	Lower	5%
	Upper	10%
	The predicted performance range for containment and recovery is based on; • remaining surface oil available for containment and recovery following weathering, • monitor and evaluate operations observing surface oil at minimum BAOAC 4 (discontinuous true oil colour) or BAOAC 5 (continuous true oil colour) • safe for deployment, within range of vessels and aircraft, • encounter rate of approximately 50-75% (50-25% of surface coverage is not surface oil)	
Response Capability details		
Containment and recovery **operation**	• 1 x containment and recovery operation includes; – 2 x suitable vessels (vessel specifications as per Marine Operations Plan) – 1 x boom system (minimum 800 mm overall height and approximately 200 m length) with all required ancillaries) or – 1 x suitable vessel (vessel specifications as per Marine Operations Plan) – 1 x single ship system (minimum 800 mm overall height and approximately 200 m length) with all required ancillaries) and – 1 x skimmer (min 20 m^3 / hr) with all required ancillaries – 1-2 x trained supervisor per operation – 8-10 x support personnel per operation	
Physical properties	**<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 >100g/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	

Expected effectiveness	• 1 x containment and recovery operation is expected to be able to contain and recover approx. 11.25-67.5 m^3 per day for the Okha PAP. This figure is based on a 5 hr (lower) to 10 hr (upper) operational day which allows for transit to the Okha location, change out of temporary waste storage equipment/ decanting and transit time between discreet oil patches. • Based on the following assumptions[9]: – 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 (lower) = 0.09 km^2 x 5 hours = 0.45 km^2 / day – Area covered per day (lower) = 0.09 km^2 x 10 hours = 0.9 km^2 / day – Recovery per day (low) = 0.45 km^2 x 50 g/m^2 x 50% coverage = 11.25 m^3 per day – Recovery per day (high) = 0.9 km^2 x 100 g/m^2 x 75% = 67.5 m^3 per 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.

[9] All parameters and efficiencies used are based upon international industry and governmental literature including IPIECA, OSRL, ITOPF, NOAA and US Bureau of Safety and Environmental Enforcement (BSEE).

5.5.2. Environmental performance based on need

Table 5-10: Environmental Performance – Containment and Recovery

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors.		
Control measure		**Performance Standard**		**Measurement Criteria (see Section 5.12)**
18	Vessel-based recovery systems	18.1	Woodside maintains an integrated fleet of vessels, including vessels with at least 10t bollard pull. Additional vessels can be sourced through existing contracts/frame agreements	1, 3A, 3B, 3C, 4
		18.2	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.	
		18.5	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.	1, 3A, 3C, 4
		18.6	Contract with waste management services for transport, removal, treatment and disposal of waste	
		18.7	Recovered hydrocarbons and wastes will be transferred to Dampier for reprocessing or disposal	
		18.8	Waste management services available and employed during response	
19	Response teams	19.1	Deployment of 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 and surface release scenario.

Available surface oil will reduce based on movement of the slick and ongoing weathering, and thus the efficiency of this response technique will also decrease significantly once surface concentrations are below thresholds for effective offshore response. Based on deterministic modelling, this is predicted to be Day 2 for MEE-05 and Day 58 for MEE-01.

- Surface concentration and mass vary for each time step based on spreading and weathering algorithms within the model. Woodside has reviewed the deterministic modelling data based on the response planning assumptions outlined above to determine the Response Need and required capability.

- **For the subsea loss of well containment scenario (MEE-01)** – Deterministic modelling predicts that there will be sufficient volumes (peak volume of 877 m^3 on Day 58, surface area peaks at 3 km^2 on Day 48) of surface hydrocarbons for containment and recovery operations to recover. Woodside's existing capability is sufficient to recover the expected surface hydrocarbons throughout the incident.
- **For the surface vessel cargo tank rupture scenario (MEE-05)** – Deterministic modelling predicts that there will be sufficient volumes of surface hydrocarbons (peak volume of 2,250 m^3 on Day 1 and surface area peaks at 15 km^2 on Day 2) available for recovery. Woodside's existing capability is not sufficient to recover all the expected remaining surface hydrocarbons in isolation before surface hydrocarbons fall below recovery thresholds. This level of capability does not exist in Australia. This technique would be secondary to surface dispersant application and be used target discrete patches of oil identified by operational monitoring.
- Permission would be sought from AMSA to decant recovered water at sea into the apex of the boom to limit the quantity of oily water waste. This would be aligned with:
  - NP-GUI016: National Plan maritime discharges of oil and oily water during emergency and response situations
  - Marine Order 91 (Marine pollution prevention – oil)
  - IPEICA Good Practice Guide 17 'The use of decanting during offshore oil spill recovery operations' (2013).
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.5.

5.6. Shoreline Protection and Deflection

The placement of containment, protection or deflection booms on and near a shoreline is a response technique to reduce the potential volume of hydrocarbons contacting or spreading along shorelines, which may reduce the scale of shoreline clean-up. Hydrocarbons contained by the booms would be collected where practicable.

Shorelines would be protected where accessible via vessel or shore. Where hydrocarbon contact has already occurred, there may still be value in deploying protection equipment to limit further accumulations and preventing remobilisation of stranded hydrocarbons.

Shoreline protection and deflection equipment would be mobilised to selected locations, where the following conditions were met:

- sea-states and hydrocarbon characteristics are safe to deploy protection and deflection measures,
- oil trajectory has been identified as heading towards identified RPAs.

5.6.1. Response need based on predicted consequence parameters

Okha FPSO Facility Operations loss of well containment (MEE-01)

The following statements identify the key parameters upon which the response need can be based:

- The shortest timeframe that shoreline contact from floating oil above threshold is predicted to be 14 days at Barrow Island (2 m^3).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact which is predicted to occur on day 14 at Barrow Island (2 m^3).
- The duration of the spill may be up to 77 days with response operations extending up to Month 4 based on the predicted time to complete shoreline clean-up operations.

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)

The following statements identify the key parameters upon which a response need can be based:

- The shortest timeframe that shoreline contact from floating oil is predicted to be 7 days at Barrow Island (42 m^3).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact which is predicted to occur on day 7 at Barrow Island (42 m^3).
- The duration of the spill may be up to 24 hours with response operations extending up to Month 2 based on the predicted time to complete shoreline clean-up operations.

All scenarios

- Predictive modelling (OM01), direct observation/surveillance (OM02) and, where appropriate, hydrocarbon detection in water (OM03), will be employed from the outset of a spill to track the oil, assess where and when appropriate response techniques can be deployed and to identify when the spill enters State Waters. When RPAs at threat of impact can be accurately deduced, this will trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04), to direct any protection and deflection operations. OM04 would be undertaken in liaison with WA DoT (if a Level 2/3 incident and within State Waters).
- Following pre-emptive assessments of sensitive receptors at risk, and in agreement of prioritisation with WA DoT (if a Level 2/3 incident and within State Waters), protection and deflection operations would commence until agreed termination criteria are reached.
- Arrangements for support organisations who provide specialist services (trained personnel, protection and deflection equipment) and/or resources should be tested regularly; and
- TRPs for RPAs along with other relevant plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for Shoreline Protection and Deflection. These assumptions have been described in the table below.

Table 5-11: Response Planning Assumptions – Shoreline Protection and Deflection

Response Planning Assumptions	
Safety considerations	Shoreline protection and deflection operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.
Shoreline Protection and Deflection	• 1 x Shoreline Protection and Deflection operation may include; – Quantity of shoreline sealing boom (as outlined in TRP) – Quantity of fence or curtain boom (as outlined in TRP) – 1-2 x trained supervisors – 8-10 x personnel / labour hire Specific details of each operation would be tailored to the TRP implemented (where available).

5.6.2. Environmental performance based on need

Table 5-12: Environmental Performance – Shoreline Protection and Deflection

Environmental Performance Outcome		To stop hydrocarbons encountering particularly sensitive areas		
Control measure		Performance Standard		Measurement Criteria (see Section 5.12)
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 24 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 48 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 mobilised within 48 hours of operational monitoring predicting impacts to each identified RPA. Expected to be 3 RPAs within 14 days (operation as detailed above).	1, 3A, 3B, 4
		22.4	14 trained personnel (2 supervisors plus 12 additional personnel) 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 48 hours.	1, 3A, 3C, 4
		23.2	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 48 hours.	1, 3C, 3D, 4
		23.3	Supplementary equipment mobilised from OSRL within 72 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 have the following expected performance:

- Deterministic modelling scenarios indicate that first shoreline impact at Barrow Island within 7 days for MEE-05 and Barrow Island within 14 days for MEE-01.
- Existing capability allows for mobilisation and deployment of shoreline protection operations by Day 1 (if required). Given shoreline contact at RPAs is not predicted until Day 7 at Barrow Island

(MEE-05), the existing capability is considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by the ongoing operational monitoring.

- TRPs have been developed for all identified RPAs predicted to be impacted in less than 14 days except in international locations.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.6.
- No further control measures that may result in an increased environmental benefit that involve moderate to significant cost and/or dedication of resources have been adopted as the timeframe required for deployment of this technique does not justify the excessive costs of identified alternate, improved or additional controls.

5.7. Shoreline Clean-up

Shoreline clean-up may be undertaken using a broad range of techniques when floating hydrocarbons contact shorelines. The timing, location and extent of shoreline clean-up activities can vary from one scenario to another, depending on the hydrocarbon type, sensitivities and values contacted, shoreline type and access, degree of oiling, and area oiled.

Shoreline clean-up is typically undertaken as a three-phase process, phase one (gross contamination removal) involving the collection of bulk oil, either floating against the shoreline or stranded on it, phase two (moderate to heavy contamination removal) involving removal or in-situ treatment of shoreline substrates such as sand or pebble beaches, 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. It includes the process for the IMT to mobilise resources depending on the nature and scale of the spill. Woodside would activate and mobilise trained and competent personnel in shoreline assessment before or following shoreline contact at response thresholds.

Shoreline clean-up consists of different manual and mechanical recovery techniques to remove hydrocarbons and contaminated debris from a shoreline; this is to minimise ongoing environmental contamination and impact. The National Plan also provides guidance on shoreline clean-up techniques as outlined in National Plan Guidance *Response, assessment and termination of cleaning for oil contaminated foreshores* (AMSA 2015).

5.7.1. Response need based on predicted consequence parameters

Okha FPSO Facility Operations loss of well containment (MEE-01)

The following statements identify the key parameters upon which the response need can be based:

- The shortest timeframe that shoreline contact from floating oil is predicted to be 14 days at Barrow Island (2 m^3) with shoreline accumulation peaking at approximately 96 m^3 in Month 3.
- The duration of the spill may be up to 77 days with response operations extending up to Month 4 based on the predicted time to complete shoreline clean-up operations.

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)

The following statements identify the key parameters upon which a response need can be based:

- The shortest timeframe that shoreline contact from floating oil is predicted to be 7 days at Barrow Island (42 m^3) with shoreline accumulation peaking at approximately 113 m^3 in Week 2.
- The duration of the spill may be up to 24 hours with response operations extending up to Month 2 based on the predicted time to complete shoreline clean-up operations.

All scenarios

- Predictive modelling (OM01), direct observation/surveillance (OM02) and, where appropriate, hydrocarbon detection in water (OM03), will be employed from the outset of a spill to track the oil, assess where and when appropriate response techniques can be deployed and when the spill enters State Waters. When RPAs at threat of impact can be accurately deduced, this will trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) and, subsequently, shoreline assessments (OM05) to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. OM04 and OM05 would be undertaken in liaison with WA DoT (if a Level 2/3 incident and within State Waters).
- Following Shoreline Assessment, and agreement of prioritisation with WA DoT (if a Level 2/3 event), clean-up operations would commence until agreed termination criteria are reached.

- 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.

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	
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	**<u>Surface Threshold for Response Planning</u>** • Lower – 100 g/m^2 – 100% coverage of 'stain' – cannot be scratched off easily on coarse sediments or bedrock • Optimum – 250 g/m^2 – 25% coverage of 'coat' – can be scratched off with a fingemail 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) – approx. 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 Cleanup 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 access ble 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.
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.

Technique	Description	Shoreline type		Application
		Recommended	Not recommended	
Vegetation cutting	Cutting vegetation to prevent oiling and reduce volume of waste and debris.	Vegetation cutting may be recommended to reduce the potential for wildlife being oiled. Where oiling is restricted to fringing vegetation.	Access in bird-nesting areas should be restricted during nesting seasons. Areas of slow-growing vegetation.	May be used on shorelines where vegetation can be safely cleared to reduce oiling.
Cleaning agents (National Plan registered Oil Spill Cleaning Agent – 'OSCA')	Application of chemicals such as dispersants to remove hydrocarbons.	May be used for manmade structures and where public safety may be a concern.	Natural substrates and in low-energy environments where sufficient mixing energy is not present.	Not recommended for shorelines. Could be used for manmade structures such as boat ramps.

5.7.2. Environmental performance based on need

Table 5-15: Environmental Performance – Shoreline Clean-up

Environmental Performance Outcome		To remove bu k and stranded hydrocarbons from shorelines and facilitate shoreline amenity habitat recovery.		
Control measure		**Performance Standard**		**Measurement Criteria (see Section 5.12)**
25	Shoreline responders	25.1	In liaison with WA DoT (for Level 2/3 incidents), deployment of 1 shoreline clean-up team to each contaminated RPA comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire • Personnel sourced through resource pool 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 48 hours of operational monitoring predicting impacts.	1, 3A, 3C, 4
		25.3	Relevant TRPs available for shoreline contacted 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 shorelines zoned and marked before clean-up operations commence to prevent secondary contamination and minimise the mixing of clean and oiled sediment and shoreline substrates	
		25.6	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy up to 1 shoreline clean-up operations by Day 5.	1, 2, 3A, 3C, 4
		25.7	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy up to 4 shoreline clean-up operations by Week 2.	
		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 >100 g/m^2 within 48 hours of operational monitoring predicting impacts.	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 48 hours.	
		26.3	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 48 hours.	1, 3C, 3D, 4
		26.4	Supplementary equipment mobilised from OSRL within 72 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	Removal of vegetation will be limited to moderately or heavily oiled vegetation	

		27.5	Oversight by trained personnel who are aware of the risks	
		27.6	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 7 at Barrow Island (MEE-05), Woodside is satisfied that the current capability is managing risks and impacts to ALARP.

The capability available meets the need identified for this activity. The shoreline clean-up capability has the following expected performance (if required during a response):

- Woodside has the capacity to mobilise and deploy up to 15-20 shoreline clean-up teams (approximately 150-200 responders in total) by week 4 at up to 5 RPAs using existing labour hire contracts with Woodside, AMOSC, Core Group, AMSA, WA DoT and OSRL team leads.
- Assessment of response capability indicates that for a worst-case scenario the actual teams required would meet the available capability and the response would be completed by Month 2 (MEE-05) and Month 4 (MEE-01).
- Woodside has considered deployment of additional personnel to undertake shoreline clean-up operations but is satisfied that the identified level of resource is balanced between cost, time and effectiveness. The most significant constraint on expanding the scale of response operations is accommodation in the Exmouth to Port Hedland region and transport of personnel and management of response generated waste. From previous assessment of accommodation in the 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 predicted to be impacted in less than 14 days 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 6.7
- No further control measures that may result in an increased environmental benefit that involve moderate to significant cost and/or dedication of resources have been adopted as the limited scale and timeframe for deployment of this technique does not justify the excessive costs of identified alternate, improved or additional controls.

5.8. 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.

5.8.1. Response need based on predicted consequence parameters

Table 5-16: Response Planning Assumptions – Waste Management

Response planning assumptions: Waste management	
Waste loading per m³ 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. 1 m^3 of oily liquid waste generated for each wildlife unit cleaned

5.8.2. 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 (see Section 5.12)**
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 675 m^3 of solid and liquid waste storage available within 5 days upon activation of 3rd party contract.	
		28.3	Access to up to 120,000m^3 waste storage by end of Month 4.	
		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.

Given the largest shoreline volumes ashore are predicted for MEE-05 during Week 2 at a maximum volume of 113 m^3, 2,653 m^3 of waste is expected across all shoreline clean-up operations during the response, and the capability available exceeds the need identified.

It indicates that the waste management capability has the following expected performance:

- Offshore operations may generate up to an additional peak of 364 m^3 oily waste for one week (Week 4) for MEE-01, and up to 4,077 m^3 oily waste for one week (Week 1) off offshore operations for MEE-05.
- Shoreline and nearshore operations may generate up to 2,653 m^3 oily waste over 2 months of operations.
- Veolia has the capacity to treat up to 120,000 m^3 overall waste volumes. The waste management requirements are within Woodside's and its service providers existing capacity.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.7.
- No further control measures that may result in an increased environmental benefit that involve moderate to significant cost and/or dedication of resources have been adopted as the current capability meets the need thus does not justify the excessive costs of identified alternate, improved or additional controls.

5.9. 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 fauna 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, Dampier and Perth. Additional personnel would be sourced through Woodside's arrangements to support an oiled wildlife response as required.

5.9.1. 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 7 at Barrow Island (42 m^3, MEE-05).
- The offshore location of the release site is expected to initially result in low numbers of at-risk or impacted wildlife.
- As the surface oil approaches shorelines, potential for oiled wildlife impacts are likely to increase.
- It is estimated that an oiled wildlife response would be between Level 2 and Level 3, as defined in the WA OWRP.

Table 5-18: Key at-risk species potentially in Priority Protection Areas and open ocean

Species	Open ocean	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Islands Group	Muiron Islands	Ningaloo Coast and WHA	Exmouth Gulf	Shark Bay
Marine turtles		✓	✓	✓	✓	✓	✓	✓	✓
Sea birds and migratory shorebirds	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cetaceans – whales	✓	✓	✓	✓		✓	✓	✓	✓
Cetaceans – dolphins and porpoises	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dugongs		✓	✓	✓	✓	✓	✓	✓	✓
Whale sharks	✓	✓	✓	✓		✓			
Sea snakes	✓	✓	✓	✓	✓	✓	✓	✓	
Sharks and rays	✓	✓		✓	✓	✓	✓	✓	✓

The oiled wildlife response technique targets key wildlife populations at risk within Commonwealth open waters and the nearshore waters as described in Section 4 of the EP. Responding to oiled wildlife consists of eight key stages, as described in Table 5-19 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 fauna from entering areas potentially contaminated by spilled hydrocarbons, as well as dispersing, displacing or relocating fauna 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 Dampier and Exmouth have been identified in the draft Regional OWROP, should a land-based site be required.
Stage 7: Wildlife rehabilitation	Considerations include a suitable rehabilitation centre and personnel, wildlife housing, record keeping and success tracking.
Stage 8: Oiled wildlife response termination	Once a decision has been made to terminate operations, the Incident Controller will stand down individual participating and supporting agencies.

Reconnaissance and primary response would be done during operational monitoring and surveillance activities. Where marine fauna 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 fauna and habitats contacted by hydrocarbons.

Staging sites would be established as forward bases for shoreline- or vessel-based field teams. Once recovered to a staging site, wildlife would be transported to the designated oiled wildlife facility or a temporary holding centre (before being transported to the oiled wildlife facility). Temporary holding centres are required when there is significant distance between a staging site and the oiled wildlife facility, to enable stabilisation of oiled animals. The oiled wildlife facility is the primary location where animals would be housed and treated. Sites proposed for staging a regional oiled wildlife response in Dampier and Exmouth have been identified.

To deploy a response that is appropriate to the nature and scale of the event, as well as scalable over time, Woodside would implement an oiled wildlife response in consultation with DBAC and use the capability outlined in the WA OWRP, with additional capability if required (e.g. volunteers) accessible through Woodside's *People & Global Capability Surge Labour Requirement Plan*.

The WA OWRP provides indicative oiled wildlife response levels (Table 5-20) 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)

Oiled wildlife response Level	Indicative personnel numbers	Indicative duration	Indicative number of birds (non-threatened species)	Indicative number of birds (threatened species)	Turtles (hatchlings, juveniles, adults)	Cetaceans	Pinnipeds	Dugongs
Level 1	6	< 3 days	1–2/day < 5 total	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

5.9.2. 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 fauna under the Animal Welfare Act 2002.		
Control measure		**Performance Standard**		**Measurement Criteria (see Section 5.12)**
29	Wildlife response equipment	29.1	Contracted capability to treat 100 individual fauna 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 fauna within a five-day period.	
		29.3	National plan access to additional resources under the guidance of the WA DoT (up to a Level 5 oiled wildlife response as specified in the OWRP), with the ability to treat about 600 individual fauna by the time hydrocarbons contact the shoreline.	1, 3C, 4
		29.4	Vessels used in hazing/pre-emptive capture will approach fauna 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 3 wildlife collection teams by Week 1 at Barrow Islands, Montebello Islands and Lowendal Islands RPAs (MEE-05).
- Mobilisation and deployment of approximately 1 wildlife collection teams by Week 3 at Pilbara Islands – Southern Islands Group RPA (MEE-05).
- Mobilisation and deployment of approximately 2 wildlife collection teams by Week 6 at Ningaloo Coast North and WHA and Muiron Islands and MMA-WHA RPAs (MEE-05).
- Mobilisation and deployment of 1 central wildlife treatment and rehabilitation locations at Dampier or Exmouth in accordance with WA OWRP, if required.

Wildlife collection operations would be expected to be completed by Month 2 based on the shoreline impacts predicted. Additional capability could be deployed but given modelling predicts that impacts will desist after the second month, additional personnel are unlikely to increase the net environmental benefit and this capability meets the need.

Woodside would establish a wildlife collection point at the RPA for identified oiled wildlife collection and sorting. From these locations, recovered wildlife would be transported to a central treatment location at Dampier or Exmouth.

5.10. Scientific monitoring

A scientific monitoring program (SMP) 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 Environment that Maybe Affected (EMBA) and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the worst-case credible spill scenarios or other identified unplanned hydrocarbon releases associated with the operational activities (refer to Table 2-1).

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), 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 ANNEX B: Operational Monitoring Activation and Termination Criteria) 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
- 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 (entrained and dissolved) detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019), as shown in Figure 5-1.

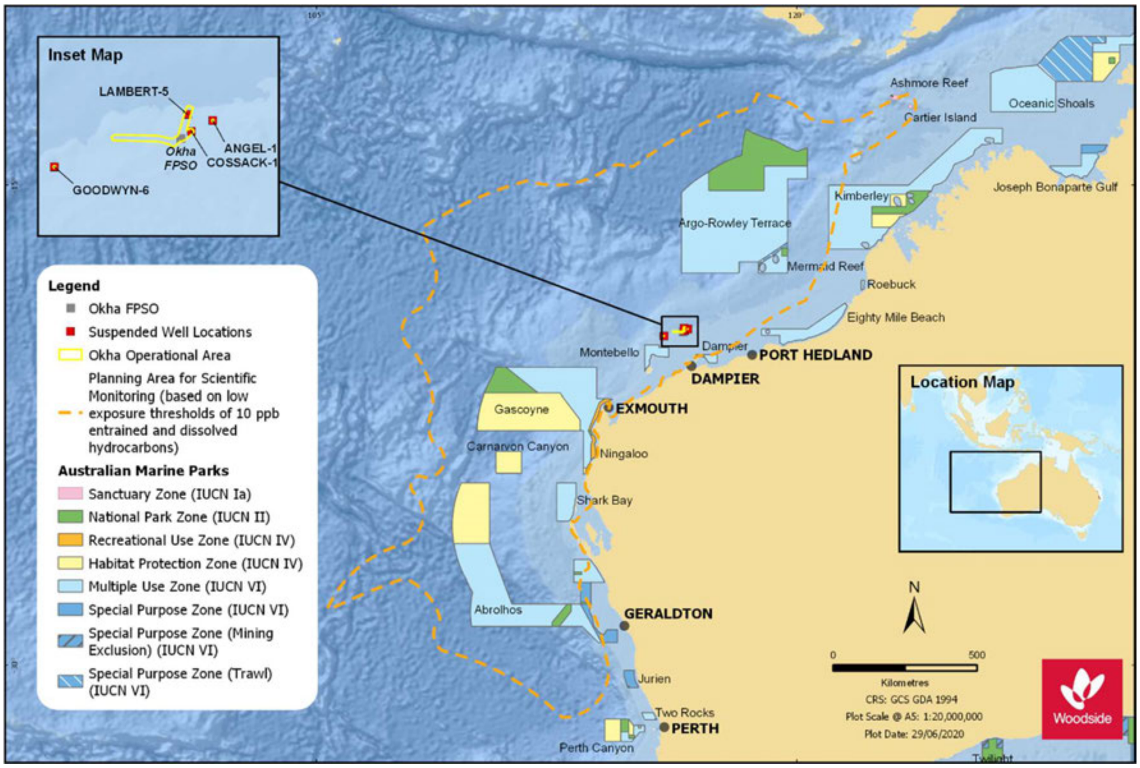

Figure 5-1: The planning area for scientific monitoring based on the area potentially contacted by the low (below ecological impact) entrained and dissolved hydrocarbon threshold of 10 ppb in the event of the worst-case credible spill scenario (MEE-01).

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 MEE-01 and therefore represents the largest spatial boundaries of 100 MEE-01 oil spill combinations, not the spatial extent of a single MEE-01 spill.

5.10.1. Scientific Monitoring Deployment Considerations

Table 5-22: Scientific monitoring deployment considerations

Scientific Monitoring Deployment Considerations	
Existing baseline studies for sensitive receptor locations predicted to be affected by a spill	PBAs of the following two categories: • PBAs within the predicted <10-day hydrocarbon contact time prediction: The approach is to conduct a desktop review of available and appropriate baseline data for key receptors for locations (if any) that are potentially impacted within 10 days of a spill and look to conduct baseline data collection to address data gaps and demonstrate spill response preparedness. Planning for baseline data acquisition is typically commenced pre-PAP and execution of studies undertaken with consideration of weather, receptor type, seasonality and temporal assessment requirements. • PBAs >10 days' time to predicted hydrocarbon contact in the event of an unplanned hydrocarbon release (from the facility operational activities). SMP activation (as per the Ohka Floating Production Storage and Offloading Facility Operations FSP) directs the SMP team to follow the steps outlined in the SMP Operational Plan. The steps include: checking the availability and type of existing baseline data, with particular reference to any PBAs identified as >10 days to hydrocarbon contact. Such information is used to identify response phase PBAs and plan for the activation of SMPs for pre-emptive (i.e. pre-hydrocarbon contact) baseline assessment.
Pre-emptive Baseline in the event of a spill	Activation of SMPs in order to collect baseline data at sensitive receptor locations with predicted hydrocarbon contact time >10 days (as documented in ANNEX C: Oil Spill Scientific monitoring Program).
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 <1 m for nearshore systems • Waves <1.5 m for offshore systems • Winds <20 knots • Daylight operations only SMP implementation will be planned and managed according to HSE risk reviews and the met-ocean conditions on a day to day basis by SMP operations.

5.10.2. Response planning assumptions

Table 5-23: Scientific monitoring response planning assumptions

Response Planning Assumptions	
PBAs	PBAs identified through the application of defined hydrocarbon impact thresholds during the Quantitative Spill Risk Assessment process and a consideration of the minimum time to contact at receptor locations fall into two categories: • PBAs for which baseline data exist or are planned for and data collection may commence pre-PAP (≤ 10 days minimum time to contact). • 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.

Response Planning Assumptions	
	Time to hydrocarbon contact of >10 days has been identified as a minimum timeframe within which it is feasible to plan and mobilise applicable SMPs and commence collection of baseline (pre-hydrocarbon contact) data, in the event of an unplanned hydrocarbon release from the Ohka Floating Production Storage and Offloading Facility Operations. PBAs for the Ohka FPSO Facility Operations are identified and listed in ANNEX D: Scientific Monitoring Program and Baseline Studies for the Petroleum Activities Program, 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 surface or entrained hydrocarbons at environmental thresholds within ≤10 days has identified the following: • Barrow Island • Montebello Islands • Lowendal Islands[10] • Montebello State Marine Park • Glomar Shoals[11] • Rankin Bank[9] For example, adequate baseline data are available for Rankin Bank and Glomar Shoals as last surveyed (benthic communities and fish assemblages) in November 2018 (Currey-Randall et al, 2019), refer to ANNEX D: **Scientific Monitoring Program and Baseline Studies for the Petroleum Activities Program** Table D-2. Australian Marine Parks (AMPs) potentially affected includes: • Montebello AMP All the 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: **Scientific Monitoring Program and Baseline Studies for the Petroleum Activities Program**, based on the PAP worst-case credible spill scenario(s) (Table 2-1). To address the initial focus in a response phase SMP planning situation, receptor locations predicted to be contacted between >10 days and 20 days have been identified as follows: • Ningaloo Coast north[12] • Muiron Islands • Pilbara Southern Island Group • Ningaloo AMP • Gascoyne AMP • Argo Rowley Terrace AMP

[10] ≤10 days time to contact is specifically applicable to Barrow Island and Montebello Islands; however, the Lowendal Islands are being included as a precautionary approach, given the spill modelling does not encompass the complex hydrographic processes for these islands groups.
[11] Floating oil will not accumulate on submerged features and at open ocean locations, therefore, no surface contact is possible with only entrained hydrocarbon contact predicted at Rankin Bank and Glomar Shoals ≤10 days.
[12] Ningaloo Coast and Muiron Islands includes the WHA, State Marine Park and Marine Management Area.

Response Planning Assumptions	
	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 start to acquire data before hydrocarbon contact). With reference to the Ohka FPSO Facility Operations, priority would be focused on the Ningaloo Coast north and Muiron Islands. ii. Highly sensitive and/or valued habitats and communities in coastal waters will be prioritised for pre-emptive baseline surveys over open water areas of AMPs e.g. Gascoyne AMP. iii. Collect baseline data for receptors predicted to be outside the spill affected area, so reference datasets for comparative analysis with impacted receptor types, can be assessed post-spill.
Baseline Data	A summary of the spill affected area and receptor locations as defined by the EMBA for the PAP worst-case credible spill MEE 1 and 5 is are presented Ohka Floating Production Storage and Offloading Facility Operations EP (Section 6). The key receptors at risk by location and corresponding SMPs based on the ecological EMBA for the PAP are presented in ANNEX D: Scientific Monitoring Program and Baseline Studies for the Petroleum Activities Program, as per the PAP worst-case 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 2 or 3 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: Oil Spill Scientific monitoring Program).

5.10.3. Summary – scientific monitoring

The resulting scientific monitoring capability has been assessed against the PAP worst-case credible spill scenarios. The range of techniques provide an ongoing approach to monitoring operations to assess and evaluate the scale and extent of impacts. All known reasonably practicable control measures have been adopted with the cost and organisational complexity of these options determined to be moderate and the overall delivery effectiveness determined to be medium. The SMP's main objectives can be met, with no additional, alternative or improved control measures providing further benefit.

5.10.4. Response planning: need, capability and gap – scientific monitoring

The receptor locations identified in ANNEX D: Scientific Monitoring Program and Baseline Studies for the Petroleum Activities Program provide the basis of the SMPs likely to be selected and activated. Once the Woodside SMP Delivery team and the SMP standby 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.

<u>Scope of SMP Operations in the event of a hydrocarbon spill:</u>

Receptor locations of interest for the SMP during the response phase are:

- Ningaloo Coast North
- Muiron Islands

Documented baseline studies are available for certain sensitive receptor locations including the Barrow Island, Montebello Islands, Lowendal Islands, Glomar Shoals, Rankin Bank and Montebello AMP (ANNEX D: Scientific Monitoring Program and Baseline Studies for the Petroleum Activities Program, 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 6.10 considers ways to reduce the gap by considering alternate, additional, and/or improved control measures on each selected response strategy.

5.10.5. Environmental performance based on need

Table 5-24: 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 a SMP standby contractor to provide scientific personnel to resource a base capability of one team per SMP (SM01-SM10, see Table C-2, ANNEX C: Oil Spill Scientific monitoring Program) 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: Oil Spill Scientific monitoring Program) 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 (standby SMP contractor) and linkage to the ICC is presented in Figure C-1, ANNEX C: Oil Spill Scientific monitoring Program. • 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 FSP. • Step by step process to activation of individual SMPs provided in the SMP Operational Plan. • All decisions made regarding SMP logged in the online 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 standup 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 standup of the Scientific Monitoring Programme (SMP) for the SMP standby contractor. • Woodside Environmental Science Team co-ordinates an annual SMP arrangement testing exercise which the SMP standby contractor. SMP team participates in since 2016 (report on 2016 SMP simulation: and SMP standby contractor the SMP	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.

	arrangements (people and equipment availability) tested annually since 2016.			
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: Oil Spill Scientific monitoring Program). • 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: Oil Spill Scientific monitoring Program)). Equipment would be sourced through the existing SMP standby contract with SMP standby 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. SMP standby contractor can also address equipment redundancy through either individual or multiple suppliers. MoUs are in place with one marine sampling equipment companies and one analytical laboratory (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	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 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.

	data prior to hydrocarbon contact required to support the post-response SMP.			
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.	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

	Woodside maintains knowledge of Environmental Baseline data through: • 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 baseline 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>Pre-emptive Baseline Area (PBA) baseline data acquisition in the response phase</u>** If baseline data gaps are identified for PBAs predicted to have hydrocarbon contact in >10 days, there will be a response phase effort to collect baseline data. Priority in implementing SMPs will be 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 2 or 3 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: Oil Spill Scientific monitoring Program.	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: Oil Spill Scientific monitoring Program, and the Termination Criteria Decision-tree for Oil Spill Environmental Monitoring (Figure C-3 of ANNEX C: Oil Spill Scientific monitoring Program):	Evidence of Termination Criteria triggered: • Documentation and approval by relevant stakeholders to end SMPs for specific receptor types.

5.11. Incident Management System

The Incident Management System is both a control measure and a measurement criteria. 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 criteria the IMS records the evidence of the timeliness of all response actions included in the environmental performance standards and the plans used of the PAP.

As the IMS does not directly remove hydrocarbons spilt into the marine environment there is no direct relationship to the response planning need.

5.11.1. Incident action planning

The ICC will be required to collect and interpret information from the scene of the incident to determine support requirements to the site-based IMT, develop an IAP and assist the IMT with the execution of that plan. The site-based IC may request the ICC to complete notifications internally within Woodside, to stakeholders and government agencies as required. Depending on the type and scale of the incident either the ICC Duty Manager (DM) or IC will be responsible for ensuring the development of the IAP. Incident Action Planning is an ongoing process that involves continual review to ensure techniques to control the incident are appropriate to the situation at the time.

5.11.2. Operational NEBA process

In the event of a response Woodside will confirm that the response techniques adopted at the time of EP/OPEP acceptance remain appropriate to reduce the consequences of the spill. This process verifies that there is a continuing net environmental benefit associated with continuing the response technique through the operational NEBA process. This process manages the environmental risks and impacts of response techniques during the spill response, an operational NEBA will be undertaken throughout the response, for each operational period.

The operational NEBA will consider the risks and benefits of conducting and response activity. For example, if vessels are required for access to nearshore or onshore areas, anchoring locations will be selected to minimise disturbance to benthic habitats. Vessel cleanliness would be commensurate with the receiving environment. The operational NEBA will consider the risks and benefits of conducting other response techniques.

The operational NEBA process is also used to terminate a response. Using data from operational and scientific monitoring activities the response to a hydrocarbon spill will be terminated in accordance with the termination process outlined in the OPEA. In effect the operational NEBA will determine whether there is net environmental benefit to continue response operations.

5.11.3. Stakeholder engagement process

Woodside will ensure stakeholders are engaged during the spill response in accordance with internal standards. This process requires that Woodside will:

- Undertake all required notifications (including government notifications) for stakeholders in the region (identified in the First-Strike Response Plan). This includes notification to mariners to communicate navigational hazards introduced through response equipment and personnel.
- In the event of a response, identify and engage with relevant stakeholders and continually assess and review.

5.11.4. Environmental performance based on need

Table 5-25: Environmental Performance – Incident Management System

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 (see Section 5.12)**
38	Operational SIMA	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 SIMA.	
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; and • 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

5.12. Measurement criteria for all response techniques

Woodside ensures compliance with environmental performance outcomes and standards through four primary mechanisms. The aforementioned performance tables 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 5-1 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

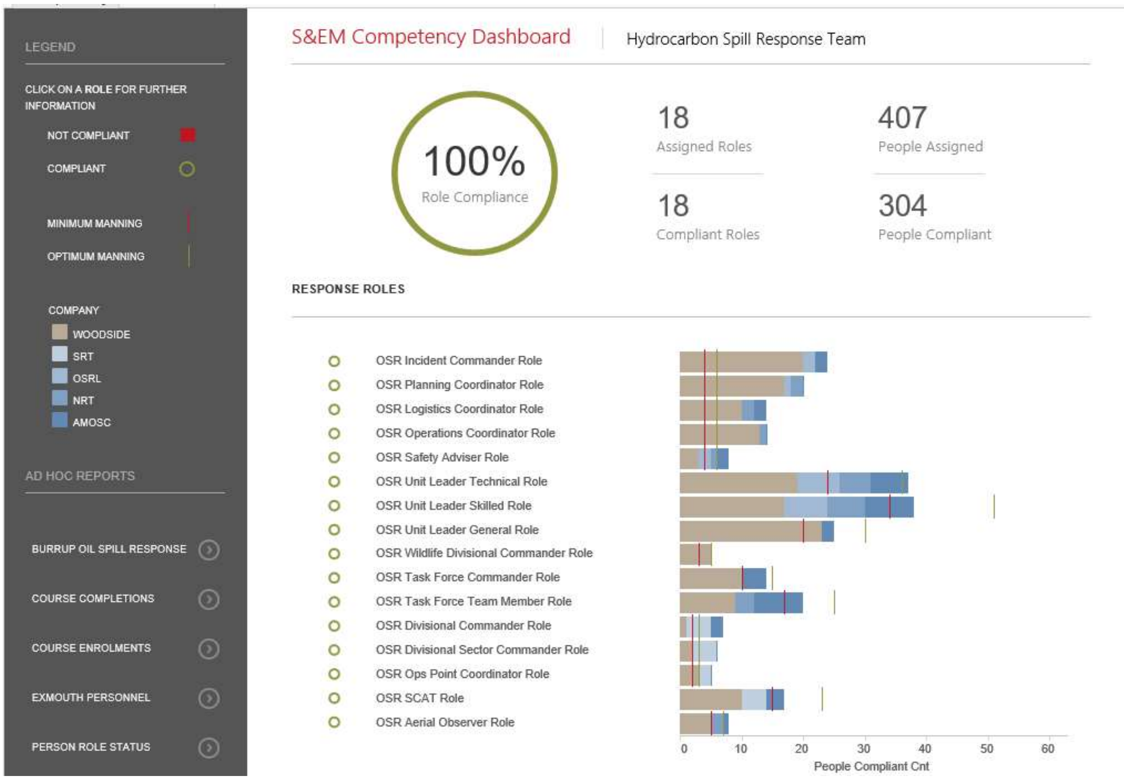

Figure 5-2: Example screen shot of the Hydrocarbon Spill Preparedness competency dashboard

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 5-2 shows deeper dive into the Ops Point Coordinator role and the training modules required to show competence.

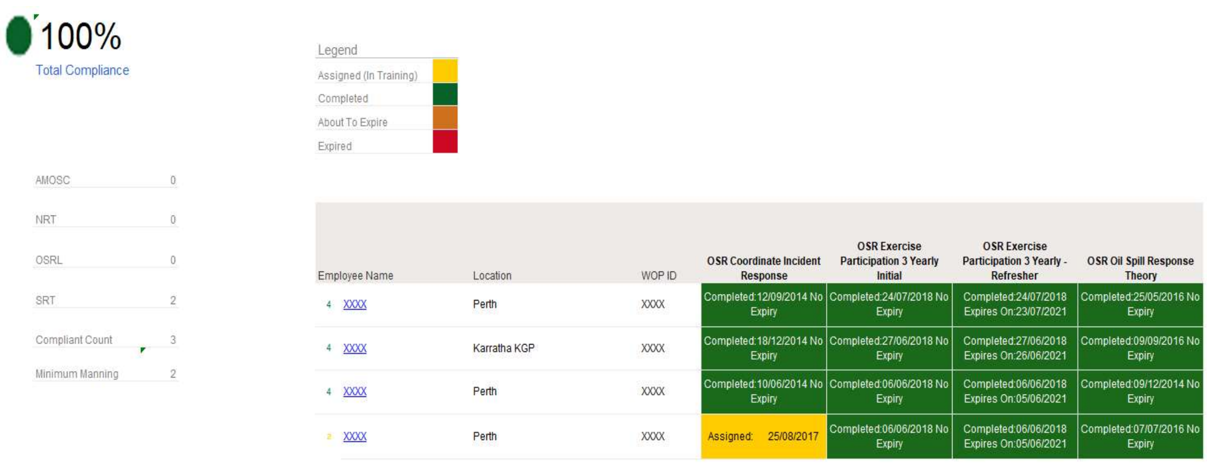

Figure 5-3: Example screen shot for the Ops Point Coordinator role

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[13] 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; and
  - Maintaining access to identified equipment and personnel.
- Planning for hydrocarbon spill response preparedness
- Accountabilities for hydrocarbon spill response preparedness
- Spill training requirements
- Requirements for spill exercising / testing of spill response arrangements
- Spill equipment and services requirements.

The procedure also details the roles and responsibilities of the dedicated Woodside Hydrocarbon Spill Preparedness team. This team is responsible for:

- Assuring that Woodside hydrocarbon spill responders meet competency requirements.

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[13] 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

- Establishing the competency requirements, annual training schedule and a training register of trained personnel.
- Establishing and maintaining the total numbers of trained personnel required to provide an effective response to any hydrocarbon spill incident.
- Ensuring equipment and services contracts are maintained.
- Establishing OPEPs.
- Establishing OPEAs.
- Priority response receptor determination.
- ALARP determination.
- Ensuring compliance and assurance is undertaken in accordance with external and internal requirements.

6 ALARP EVALUATION

This Section should be read in conjunction with Section 5 which is the capability planned for this activity.

6.1. Monitor and Evaluate – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.1.1. Monitor and Evaluate – Control Measure Options Analysis

6.1.1.1. Alternative Control Measures

Alternative Control Measures considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Aerostat (or similar inflatable observation platform) for localised aerial surveillance.	Lead time to Aerostat surveillance is disproportionate to the environmental benefit. The system also provides a very limited field of visibility around the vessel it is deployed from.	Long lead time to access (>10 days). Each system would require an operator to interpret data and direct vessels accordingly. Requires multiple systems for shoreline use.	Purchase cost per system approx. A$300,000.	This option is not adopted as the minimal environmental benefit gained is disproportionate to the cost and complexity of its implementation.	No
Use of Autonomous Underwater Vehicles (AUVs) for hydrocarbon presence and detection.	Use of AUVs may be feasible and may provide an environmental benefit in assessing inaccessible areas for presence of hydrocarbons in the water however cost of purchase is disproportionate to the environmental benefit when compared to the monitoring types in place.	AUVs may be considered as an additional method of monitoring, should remote systems be required for health and safety reasons.	Cost A$10,000 for mobilisation and A$15,000 a day when deployed.	This option is not adopted as other monitoring techniques already in place meet the need and have lower implementation costs.	No

6.1.1.2. Additional Control Measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional personnel trained to use systems.	Current arrangement provides an environmental benefit in the availability of trained personnel facilitating access to monitoring data used to inform all other response techniques. No improvement required.	No improvement can be made, all personnel in technical roles e.g. intelligence unit are trained and competent on the software systems. Personnel are trained and exercised regularly. Use of the software and systems forms part of regular work assignments and projects.	Cost for training in-house staff would be approx. A$25,000.	This option is not adopted as the current capability meets the need.	No
Additional satellite tracking buoys to enable greater area coverage.	Increased capability does not provide an environmental benefit compared to the disproportionate cost in having an additional contract in place.	Tracking buoy on location at manned facility, additional needs are met from Woodside owned stocks in King Bay Support Facility (KBSF) and Exmouth or can be provided by service provider.	Cost for an additional satellite tracking buoy would be A$200 per day or A$6000 to purchase.	This option is not adopted as the current capability meets the need, but additional units are available if required.	No
Additional trained aerial observers.	Woodside has access to a pool of trained, competent observers at strategic locations to ensure timely and sustainable response. Additional observers are available through current contracts with AMOSC and OSRL.	Aviation standards & guidelines ensure all aircraft crews are competent for their roles. Woodside maintains a pool of trained and competent aerial observers with various home base locations to be called upon at the time of an incident. Regular audits of oil spill response organisations ensure training and competency is maintained.	Cost for additional trained aerial observers would be A$2000 per person per day.	This option is not adopted as the current capability meets the need, but additional observers are available via response contractors if required.	No

6.1.1.3. Improved Control Measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster turnaround time from modelling contractor.	Improved control measure does not provide an environmental benefit compared to the disproportionate cost in having an additional contract in place.	External contractor on ICC roster to be called as soon as required. However initial information needs to be gathered by ICC team to request an accurate model. External	Modelling service with a faster activation time would be achieved via membership of an alternative modelling	This option is not adopted as the minimal environmental benefit gained is	No

		contractor has person on call to respond from their own location.	service at an annual cost of A$50,000 for 24hr access plus an initial A$5000 per modelling run.	disproportionate to the cost and complexity of its implementation.	
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 A$15M/year per vessel) is considered disproportionate to the potential environmental benefit to be realised by adopting this delivery options.	Operations are not feasible on day 1 as the hydrocarbon will take time to surface, and volatility has potential to cause health concerns within the first 24 hours of the response.	Cost for purchase of equipment approx. A$200,000. Ongoing costs per annum for cost of hire and pre-positioning for life of asset/activity would be larger than the purchase cost. Dedicated equipment and personnel, living locally and on short notice to mobilise. The cost would be approx. A$1 m per annum, which is disproportionate to the incremental benefit this would provide, assets are already available on day 1. 2 integrated fleet vessels are available from day 1, however these could be tasked with other operations.	This option is not adopted as the area could not be accessed earlier due to safety considerations. Additionally, the cost and complexity of implementation outweighs the benefits.	No

6.1.2. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.2. Source Control – ALARP Assessment

Woodside has based its response planning on the worst-case credible scenario (as described in Section 1.1). This includes the following selection of primary source control and well intervention techniques which would be conducted concurrently;

- ROV intervention
- Debris clearance and/or removal
- 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 (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 Okha FPSO Operations (days)
Source and mobilise vessel with work class ROV	2 days
Liaise with Regulator regarding risks and impacts*	4 days
Undertake ROV Inspection	1 day
TOTAL	**7 days***

** Based on timings from the Report into the Montara Commission of Enquiry, submission and discussion of revised documentation for limited activities inside the Petroleum Safety Zone (water deluge operations) to manage personnel risks and impacts was up to 20 days.*

6.2.1.1. Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-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 –source and contract a MODU outside Australia with an approved Australian Safety Case.

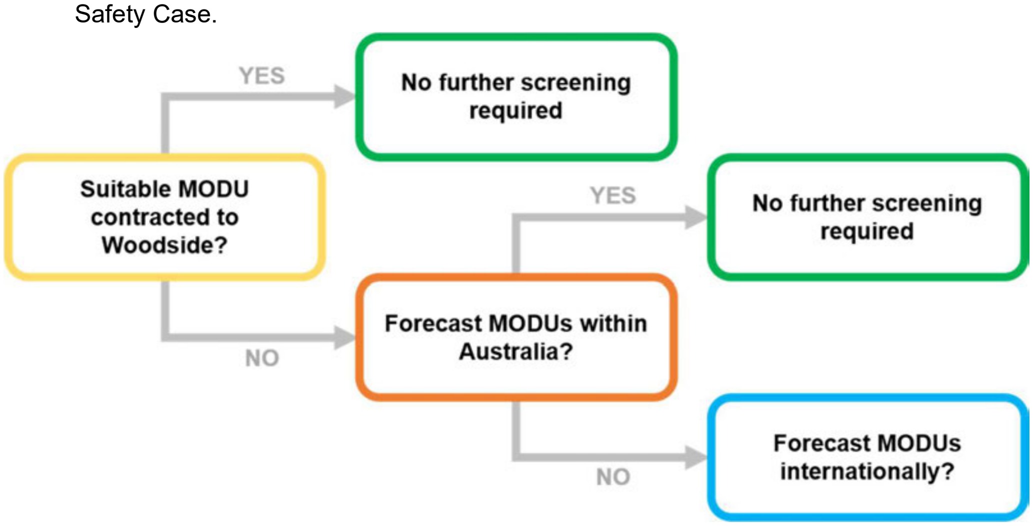

Figure 6-1: Okha process for sourcing relief well MODU

The internal and external availability of moored MODUs, plus rig activities of registered operators and rigs with approved safety cases, are tracked by Woodside on a monthly basis, with a two-year look ahead, to ensure that the best available option can be sourced and utilised in the event of the worst-case credible scenario.

If the above forecast indicates a gap in availability of a suitable MODU for relief well drilling within Australia, screening would be extended to MODUs with a valid safety case outside Australia. If an international MODU with an Australian safety case is not identified, an internal review will be undertaken, NOPSEMA notified and the issue tabled at the APPEA Drilling Industry Safety Committee. A review of the significance of the change in risk will be undertaken in accordance with Woodside's environment management of change requirements and relevant regulatory triggers. The aforementioned lookahead timeframe would allow two years' warning of any potential gap. Woodside will execute relief well drilling in the fastest possible timeframe.

Based on the detail provided, these 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 5.2.

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 Okha FPSO Facility Operations. 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. Dynamically positioned and most jack up rigs are not suitable for the Okha FPSO water depth, therefore a moored MODU would be required and thus has been used as the basis for the analysis within this document.

To validate the effectiveness of the relief MODU supply arrangements through the APPEA MoU, the 21-day mobilisation period was tested in April 2019 in an exercise facilitated by an external party. This exercise included suspension of the assisting operator's activities, contracting the MODU, vessel safety case revision and transit to location. The testing of mobilisation arrangements has been incorporated into Woodside's Hydrocarbon Spill Arrangements Testing Schedule.

Table 6-2: Relief well drilling timings

	Estimate Relief Well duration for Okha FPSO Operations (days)
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, 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:

- 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.

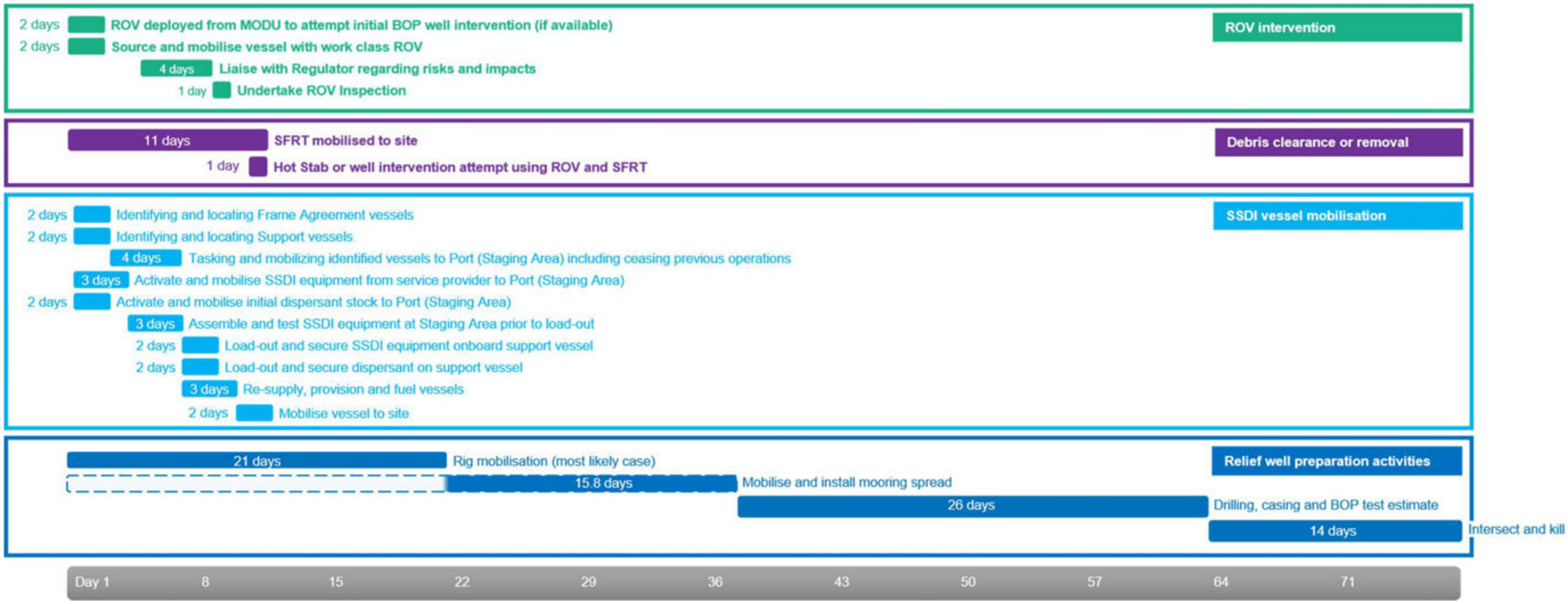

Figure 6-2: Source control and well intervention response strategy deployment timeframes

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 5.2.

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 with a two-year lookahead.
- Prioritisation of rigs/vessels with current or historical contracting arrangements. Woodside maintains records of previous contracting arrangements and companies. All current contracts for vessels and rigs are required to support Woodside in the event of an emergency.
- Leverage mutual aid arrangements such as the APPEA MOU for vessel and rig support.
- Woodside Planning and Logistics, and Safety Officers (on-Roster/Call 24/7) which can articulate need for, and deliver Woodside support, in key delivery tasks including sitting with potential outside operators.
- Ongoing strategic industry engagement and collaboration with NOPSEMA to work toward time reductions in regulatory approvals for emergency events.

Woodside has identified three safety case revision development and submission scenarios for a MODU and plotted these alongside the relief well preparation activities in Figure 6-3. The assumptions for each of the cases are detailed subsequently in 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 Okha 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.

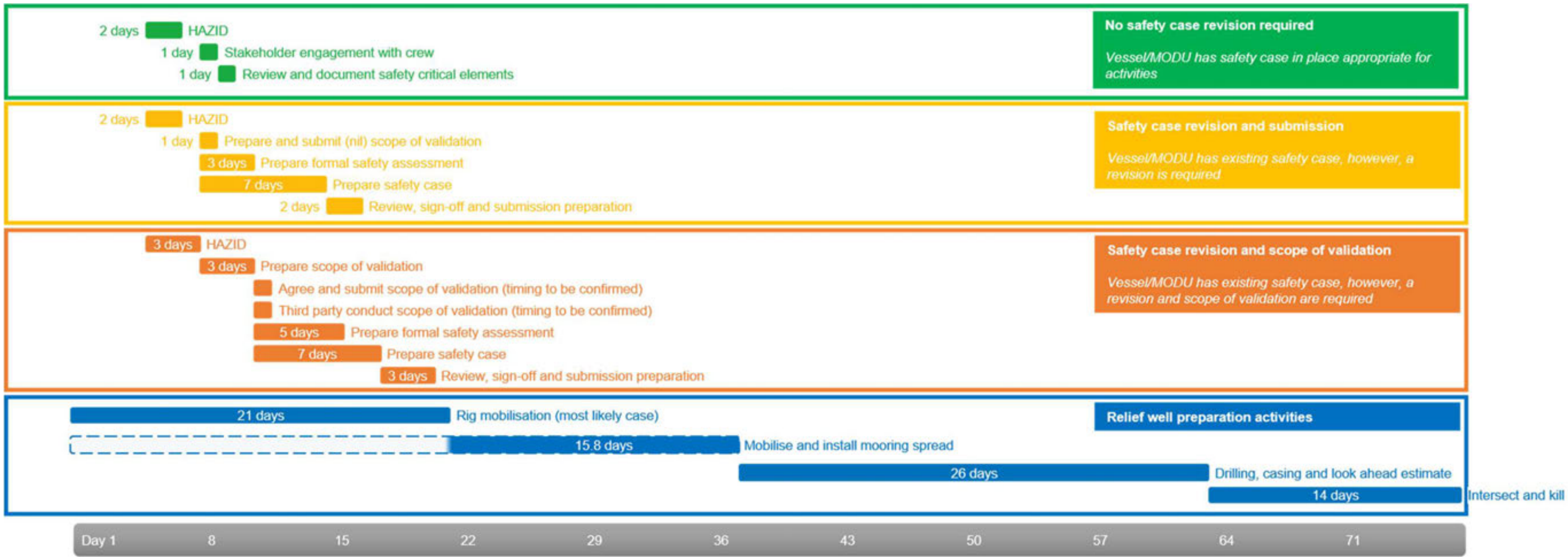

Figure 6-3: Timeline showing safety case revision timings alongside relief well preparation activity timings

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 assessment described in Sections 6.2.1, 6.2.2 and 6.2.3 outlines the primary source control activities that that Woodside would implement.

Woodside has outlined the options considered against the activation, mobilisation (improved options), deployment (alternate and additional 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

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 24,140 m^3 of Cossack Light 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 (approx 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 16,898 m^3 of Cossack Light 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

Improved control measures Considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Feasibility**	**Environmental benefits/impacts**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Monitor internal drilling programs for rig availability	Woodside may be conducting other activities 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**	**Approximate 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 5 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 WWCI and Oceaneering	Woodside has an agreement in place with WWCI and Oceaneering to provide trained personnel in the event of an incident. This will ensure that competent personnel are available in the shortest possible timeframe.	Having contracts in place to access trained, competent personnel in the event of an incident would reduce 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 not considered disproportionate 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**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Maintaining relief well drilling supplies	There is not predicted to be any reduction in relief well timing or spill duration from Woodside maintaining stocks of drilling supplies (mud, casing, cement, etc.)	It would be feasible to source some relief well drilling supplies such as casing but the actual composition of the cement and mud required will need to be specific to the well. This option is also not deemed necessary as the lead time for sourcing and mobilising these supplies is included in the 21 days for sourcing and mobilising a rig.	The capital cost of Woodside purchasing relevant drilling supplies is expected to be approximately A$600,000 with additional costs for storage and ongoing costs for replenishment. These costs are considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit.	No

6.2.7. 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 WWCI and Oceaneering to supply trained, competent personnel
- Improved
  - Monitor internal drilling programs for MODU availability
  - Monitor external activity for MODU availability
  - Monitor status of Registered Operators / Approved Safety cases for MODUs

6.3. Subsea Dispersant Injection - ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.3.1. Subsea Dispersant Injection timing

The scope of existing safety cases for Frame Agreement vessels includes all relevant activities for SSDI operations. Depending on the location and availability of vessels, Woodside expects the SSDI capability can be mobilised to site for deployment within 12 days. This may be able to be achieved faster if vessels are closer to appropriate staging areas and not already involved in other operations. The following steps are included within the indicative timeframe and many of these are expected to be concurrent activities, as shown in Figure 6-3.

1. Identifying and locating Frame Agreement vessels (1-2 days)
2. Identifying and locating Support vessels (1-2 days)
3. Tasking and mobilising identified vessels to Port (Staging Area) including ceasing previous operations (2-4 days)
4. Activate and mobilise SSDI equipment from service provider to Port (Staging Area) (2-3 days)
5. Activate and mobilise initial dispersant stock to Port (Staging Area) (1-2 days)
6. Assemble and test SSDI equipment at Staging Area prior to load-out (2-3 days)
7. Re-supply, provision and fuel vessels (1-2 days)
8. Load-out and secure SSDI equipment onboard ISV (1-2 days)
9. Load-out and secure Dispersant on Support Vessel (1-2 days)
10. Contingency for unforeseen events (1 day)

6.3.2. Response Planning: Okha FPSO Facility Operations loss of well containment (MEE-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 5.3, the subsea dispersant injection system (as part of the SFRT package) is able to deliver approx. 60-75 m^3 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 – m^3	2,414	2,414	2,414	2,414	2,414	2,414	2,414	16,898	16,898	16,898	72,420	45,866
A	**Capability available - m^3**												
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	75	75	75	75	150	525	2,100	2,100
B	**Subsea release oil remaining - m^3**												
B1*	Predicted oil volume not treated (Okha FPSO Facility Operations) (lower)	2,414	2,414	2,414	2,414	2,414	2,414	2,414	16,898	13,298	4,298	22,020	-4,534
B2*	Predicted oil volume not treated (Okha FPSO Facility Operations) (upper)	2,414	2,414	2,414	2,414	2,414	2,414	2,414	12,398	7,898	-14,602	-53,580	-80,134

A1 and A2 – the upper and lower volumes in m^3 that subsea dispersant injection may be able to treat (based on response planning assumptions in Section 5.3 and volumes in A3 and A4). These are based on a 1:50 ratio for A1 and a 1:100 ratio for A2

A3 and A4 - the upper and lower volumes in m^3 of the associated dispersant injection volumes for A1 and A2,

B1 and B2 – the upper and lower volumes in m^3 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))

6.3.3. Subsea Dispersant Injection – Control Measure Options Analysis

6.3.3.1. Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Dedicated, contracted ISV for SSDI mobilisation and deployment (based in Australia)	Reducing the mobilisation and deployment time of the SSDI through vessel standby/pre-positioning is unlikely to result in a significant change in environmental benefit. Under current arrangements the SSDI system can be on location from approx. day 12 depending on ISV availability where a dedicated, contracted vessel may enable the SSDI system on location from day 10. Once deployed the SSDI will be utilised to increase entrainment of released oil and to ensure safe operations for surface deployment of SFRT and other surface response techniques.	A modified Construction vessel or vessels with suitable remote operated underwater vehicles (ROVs) is required to load, transport and deploy the SSDI system. The critical element in deployment of the SSDI is the availability of an appropriate ISV. Achieving a shorter mobilisation would require the vessel's work schedule to be permanently restricted so as to permit a quicker return to Dampier, reducing the utilisation of the vessel, or the permanent retention of a dedicated ISV. Neither option is considered reasonably practicable. Acceleration is limited by availability of the SSDI system mobilisation and this control measure is not expected to reduce the estimated extent and magnitude of impact from a well release on receptor locations compared with the proposed mobilisation plan using pre-identified or vessels available through frame agreements.	A dedicated vessel on standby in Dampier, ready to load is estimated to cost A$20 m per annum. This is considered 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 Dampier, reducing the utilisation of the vessel, or the permanent retention of a dedicated ISV. Neither option is considered reasonably practicable. This option is not considered feasible for a number of Titleholders due to the remote distances in Australia as well as a substantial range of well depths, types, complexities, geologies and geophysical properties across a range of Titleholders. Additionally, acceleration is limited by availability of the SSDI system mobilisation and this control measure is not expected to reduce the estimated extent and magnitude of impact from a well release on receptor locations compared with the proposed mobilisation plan using pre-identified or vessels available through frame agreements.	A dedicated vessel on standby in Dampier, ready to load is estimated to cost A$20 m per annum. As a shared cost across a range of titleholders, this may be approximately A$2 m each. This is considered 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

6.3.3.2. Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Pre-identifying / contracting vessels through Frame Agreements for SSDI loading and operations	Ensuring the mobilisation and deployment time of the SSDI through vessel availability / contracting strategy is likely to result in a moderate environmental benefit as using these arrangements, the SSDI will be on location from approximately Day 12.	Achieving a shorter mobilisation would require the vessel being on standby with limited duties to permit a faster return to Dampier and this is not considered reasonably practical. Woodside has established frame agreements with vessel providers and will track availability of similar vessels. These options are both considered reasonably practicable.	Associated cost of implementation is minimal to the environmental benefit gained.	This control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

6.3.4. Selected Control Measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected

- Additional
  - Pre-identifying / contracting vessels through Frame Agreements for SSDI loading and operations
- Improved
  - None selected

6.4. Surface Dispersant Application – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.4.1. Existing capability - Surface Dispersant Application

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below and is 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 SDA 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 SDA (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 SDA (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 SDA (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 SDA (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 SDA (lower) – km^2	0	2	7	15	17	19	19	136	136	136	582	582
E1.8	Predicted surface area treated by SDA (upper) – km^2	0	12	17	32	32	32	32	223	223	223	954	954
E2	**Existing level of SDA capability available – Vessel Dispersant Application (m^3)**												
	By Volume - m^3												
E2.1	Predicted oil contacted by SDA (lower) - m^3	50	50	50	50	100	100	100	700	700	700	3,000	3,000
E2.2	Predicted oil dispersed by SDA (lower) - m^3	23	23	23	23	46	46	46	322	322	322	1,380	1,380
E2.3	Predicted oil contacted by SDA (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 SDA (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 SDA (lower) – km^2	2	2	2	2	3	3	3	22	22	22	96	96
E2.8	Predicted surface area treated by SDA (upper) – km^2	2	3	6	6	6	10	10	45	45	45	120	120

6.4.2. Response Planning: Okha FPSO Facility Operations – loss of well containment (MEE-01)

Deterministic modelling scenarios indicate that first shoreline impact at Barrow Island occurs within 14 days for the loss of well containment scenario (MEE-01). The deterministic model run selected for response planning, however, does not contact Barrow Island and the initial impact is at Ningaloo Coast on Day 75. This model run was selected to demonstrate how a larger scale surface dispersant operation would be developed and implemented.

Modelling results at defined response thresholds (>50 g/m^2) indicate that the subsea release from scenario MEE-01 is not expected provide widespread 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. Modelling predicts there is unlikely to be large surface concentrations at BAOAC 5 (greater than 200g/m^2) and will be below 15,000 cSt due to spreading, weathering and dissolution through the water column. Due to this weathering and the extensive subsea movement of hydrocarbons from currents at different water depths, there will be limited volumes and surface area available for surface dispersant operations.

Modelling results at defined response thresholds (>50 g/m^2 and <15,000 cSt) where surface dispersants are likely to be effective indicate that the subsea release from MEE-01 is expected to be available for surface dispersant operations for up to two months (based on predicted dispersant effectiveness). From approximately Month 2, modelling predicts there are no longer sufficient surface hydrocarbons to treat with surface dispersant application due to spreading, weathering and entrainment.

To remove the majority of the surface hydrocarbons before shoreline contact would require the treatment of the majority of the initial surface release (197 m^3 available surface oil in Week 2). This would require 1 m^3-6 m^3 of dispersant delivery in Week 2 from 1 Fixed Wing Aerial Dispersant Contract (FWADC) aircraft. The surface area of hydrocarbons within threshold values peaks at 15 km^2 in Month 2 and would require 2 FWADC and 2 large capacity aircraft covering approximately 3-4 km^2 per aircraft per day.

Current capability will meet the required response need from Day 2 for the available surface area (0 km^2) and volume (0 m^3) above treatable threshold concentrations, and onwards for the loss of well containment scenario (MEE-01). Additionally, there will be limitations on available surface area that can be treated as aircraft operations from Dampier will have a predicted upper limit of 6 aircraft undertaking approximately 18-24 sorties per day based on aviation operation limitations (daylight operations, transit time to surface hydrocarbons, ground support, turnaround/refuelling times).

For the purpose of capability demonstration below, Woodside has shown that sufficient capability exists to commence and continue SDA until surface hydrocarbons no longer meet threshold parameters (approximately Month 2).

Table 6-7: Okha FPSO Facility Operations loss of well containment (MEE-01) – Release volumes

Okha FPSO Facility Operations loss of well containment (MEE-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
	Oil on sea surface												
A	Total volume of oil released (subsea) – m^3	2,414	2,414	2,414	2,414	2,414	2,414	2,414	16,898	16,898	16,898	72,420	45,866
B	Cumulative volume released – m^3	2,414	4,828	7,242	9,656	12,070	14,484	16,898	33,796	50,694	67,592	140,012	185,878
C	Total volume of surface oil remaining after weathering (per day) – m^3	369	369	369	369	369	369	369	2,585	2,585	2,585	11,080	7,017

A and B - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge scenario of a loss of well containment of the Okha FPSO Facility Operations well. The total volume for this spill is released over approximately 77 days with a daily flow rate of 2,414 m^3 / day.

C - The Okha FPSO Facility Operations Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 12.0% 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. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers. The whole oil has low asphaltene content (<0.05%), 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 14.5% by mass of the whole oil, with a moderate proportion (7.4%) in the C4-C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolution of a proportion of them into the water.

Table 6-8: Okha FPSO Facility Operations loss of well containment (MEE-01) – Treatable hydrocarbons

Okha FPSO Facility Operations loss of well containment (MEE-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
C	**Treatable hydrocarbons following weathering**												
C1	**Total volume of surface oil >50g/m^2 – m^3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**197**	**0**	**347**	**900**	**0**
C2	**Total surface area >50g/m^2– km^2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**5**	**15**	**0**
	Dispersable hydrocarbons												
C3	**Surface oil volume >50g/m^2 and viscosity <15,000 cSt – m^3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**197**	**0**	**347**	**900**	**0**
C4	**Surface area >50g/m^2 and viscosity <15,000 cSt – km^2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**5**	**15**	**0**

C1 – indicates the total remaining volume of hydrocarbons in cubic metres (m^3) on the sea surface above 50g/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.

C2 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50g/m². This is the total surface area of BAOAC 4 and above that can be treated by containment and recovery and surface dispersant spraying operations.

C3 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50g/m² and below 15,000 cSt. This is the total volume of oil that can potentially be treated by surface dispersant spraying operations.

C4 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50g/m² and below 15,000 cSt. This is the total surface area of BAOAC 4 and above that can potentially be treated by surface dispersant spraying operations.

6.4.2.1. Response Planning Need: Okha FPSO Facility Operations loss of well containment (MEE-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 >200g/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 6-11. For the Okha FPSO Facility Operations loss of well containment scenario, due to the chemical and physical properties of the oil and subsea release, there is no surface oil predicted at BAOAC 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 (BAOAC 4 for this scenario) 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: Okha FPSO Facility Operations loss of well containment (MEE-01) – Response Planning Need

Okha FPSO Facility Operations loss of well containment (MEE-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**												
	Surface area of BAOAC 5 (>200 g/m²) – km²	0	0	0	0	0	0	0	0	0	0	0	0
	Surface area of BAOAC 5 (>200 g/m²) and <15,000 cSt – km²	0	0	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) - m³	0	0	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) and <15,000 cSt - m³	0	0	0	0	0	0	0	0	0	0	0	0
D2	**Bonn Agreement Oil Appearance Code (BAOAC) 4 – Discontinuous True oil colour**												
	Surface area of BAOAC 4 (50-200 g/m²) – km²	0	0	0	0	0	0	0	3	0	5	15	0
	Surface area of BAOAC 4 (50-200 g/m²) and <15,000 cSt – km²	0	0	0	0	0	0	0	3	0	5	15	0
	Volume of surface oil BAOAC 4 (50-200 g/m²) - m³	0	0	0	0	0	0	0	197	0	347	900	0
	Volume of surface oil BAOAC 4 (50-200 g/m²) and <15,000 cSt - m³	0	0	0	0	0	0	0	197	0	347	900	0
D3	**Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen**												
	Surface area of BAOAC 3, 2 and 1 (<50 g/m²) – km²	33	3	10	15	57	118	101	210	145	1,159	1,936	517
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m²) - m³	208	41	68	49	361	781	441	1,001	502	7,457	10,634	1,381

6.4.2.2. Surface Dispersant Operations loss of well containment (MEE-01): Surface area and surface volume

Surface Dispersant operations using vessels and aircraft would target the identified heavy (BAOAC 4 and 5) patches of oil as this technique is able to treat larger volumes and surface areas than containment and recovery and is subject to a window of opportunity (prior to spreading below 50g/m² and/or viscosity increasing above 15,000 cSt).

The surface area of thickest oil (BAOAC 4 and <15,000 cSt) available for surface dispersant application peaks at approximately 15 km² in Month 2 where surface concentration and viscosity thresholds are met. By this time, Woodside would have daily use of seven FWADC and at least one larger aircraft from OSRL, each able to undertake at least two sorties each per day, operating from airfields in Dampier. These could cover approximately 672 km² and contact from 21,728 m³-46,908 m³ surface oil plus six vessels conducting dispersant spraying daily covering approximately 3 km² per response operation (504 km² total) and treating 6,720 m³ to 13,440 m³ of surface oil in Month 2.

This capability is sufficient to treat the surface area of BAOAC 4 at full spraying rate (50 l/hectare) and the dispersant application volume would treat the available surface volume (900 m³).

6.4.3. Response Planning: Okha FPSO Facility Operations – vessel cargo tank rupture (MEE-05)

Deterministic modelling scenarios indicate that first shoreline impact occurs at Barrow Island within 7 days for the vessel cargo tank rupture scenario (MEE-05). The deterministic model run selected for response planning, however, does not contact Barrow Island until approximately Day 12. This model run was selected to demonstrate how a larger scale surface dispersant operation would be developed and implemented.

On Day 1, modelling predicts 2,251 m³ surface hydrocarbons above threshold of >50g/m² and approximately 9 km² of surface area at dispersible concentrations. When viscosity thresholds are also considered, the surface volume >50g/m² and with viscosity <15,000 cSt, still peaks at 2,251 m³ and approximately 9 km² of surface area at dispersible concentrations on Day 1. Surface area peaks at 15 km² on Day 2.

Current capability will meet the required response need from Day 3 due to surface concentrations falling below threshold and remaining so for the remaining duration of scenario MEE-05 . As spreading and weathering occurs, there will be limitations on available surface area that can be treated. Additionally, aircraft operations from Dampier will have a predicted upper limit of 6 aircraft undertaking approximately 18-24 sorties per day based on aviation operation limitations (daylight operations, transit time to surface hydrocarbons, ground support, turnaround/refuelling times).

Table 6-10: Response Planning Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Release volumes

Okha FPSO Facility Operations – vessel cargo tank rupture (MEE-05)		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 (surface) - m³	30,302	0	0	0	0	0	0	0	0	0	0	0
B	Total volume of surface oil remaining after weathering (per day) - m³	4,636	0	0	0	0	0	0	0	0	0	0	0

A - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge. The total volume for this spill is 30,302 m³ which is released over approximately 24 hours.

B - The Okha FPSO Facility Operations Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 12.0% 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. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers. The whole oil has low asphaltene content (<0.05%), 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 14.5% by mass of the whole oil, with a moderate proportion (7.4%) in the C4-C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolution of a proportion of them into the water.

** - For the deterministic modelling run selected, the shoreline impact occurs from Day 7.*

Table 6-11: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Treatable hydrocarbons

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)		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	Total volume of surface oil >50g/m² – m³	2,251	1,633	0	0	0	0	0	0	0	0	0	0
C2	Total surface area >50g/m²– km²	9	15	0	0	0	0	0	0	0	0	0	0
	Dispersable hydrocarbons												
C3	Surface oil volume >50g/m² and viscosity <15,000 cSt – m³	2,251	1,633	0	0	0	0	0	0	0	0	0	0
C4	Surface area >50g/m² and viscosity <15,000 cSt – km²	9	15	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 50g/m². Based on the information outlined in Section 2.3.2.1 regarding surface concentration thresholds, this is the total volume of oil that can be treated by surface dispersant spraying and containment and recovery operations.

C2 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50g/m². This is the total surface area of BAOAC 4 and above that can be treated by surface dispersant spraying and containment and recovery operations.

C3 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50g/m² and below 15,000 cSt. This is the total volume of oil that can potentially be treated by surface dispersant spraying operations.

C4 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50g/m² and below 15,000 cSt. This is the total surface area of BAOAC 4 and above that can potentially be treated by surface dispersant spraying operations.

6.4.3.1. Response Planning Need: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – 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 >200g/m² and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200g/m².

For a surface release, the thickest oil is typically in the leading edge of the slick, driven by wind and currents. As the spill continues to weather and spread over a number of days and weeks, the surface concentration and surface area of continuous oil colour spreads and reduces to discontinuous true oil colour and finally sheen as shown below.

The response need is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-8 above. In order to target response operations, Woodside would deploy surface dispersant spraying at the leading edge. This approach would result in the greatest volume and surface area treated by surface dispersant operations but may also limit the geographic area and effectiveness of containment and recovery as these operations cannot be conducted under or near the surface dispersant spraying operations due to personnel safety reasons. In evaluating the response need for offshore operations, surface dispersant application is prioritised for BAOAC 5.

Table 6-12: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Response Planning Need

Okha FPSO Facility Operations – vessel cargo tank rupture (MEE-05)		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												
	Surface area of BAOAC 5 (>200 g/m²) – km²	5	0	0	0	0	0	0	0	0	0	0	0
	Surface area of BAOAC 5 (>200 g/m²) and <15,000 cSt – km²	5	0	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) - m³	1,706	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	1,706	0	0	0	0	0	0	0	0	0	0	0
D2	Bonn Agreement Oil Appearance Code (BAOAC) 4 – Discontinuous True oil colour												
	Surface area of BAOAC 4 (50-200 g/m²) – km²	4	15	0	0	0	0	0	0	0	0	0	0
	Surface area of BAOAC 4 (50-200 g/m²) and <15,000 cSt – km²	4	15	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 4 (50-200 g/m²) - m³	545	1633	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	545	1633	0	0	0	0	0	0	0	0	0	0
D3	Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen												
	Surface area of BAOAC 3, 2 and 1 (<50 g/m²) – km²	39	74	109	64	62	67	73	488	102	55	79	0
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m²) - m³	383	759	770	329	309	297	288	1,281	149	80	107	0

6.4.3.2. Surface Dispersant Operations vessel cargo tank rupture (MEE-05): Surface area and surface volume

Surface Dispersant operations using vessels and aircraft would target the identified heavy (BAOAC 4 and 5) patches of oil as this technique is able to treat larger volumes and surface areas than containment and recovery and is subject to a window of opportunity (prior to spreading below 50g/m² and/or viscosity increasing above 15,000 cSt).

The surface area of thickest oil (BAOAC 4 and 5 and <15,000 cSt) available for surface dispersant application peaks at approximately 15 km² on Day 2 where surface concentration and viscosity thresholds are met. By this time, Woodside would expect 1 Fixed Wing Aerial Dispersant Contract (FWADC) aircraft along with 1 larger aircraft from OSRL, to be operating from airfields in Dampier covering approximately 6-8 km² and contacting from 96 m³-537 m³ plus 1-2 vessels conducting dispersant spraying covering approximately 3 km² and treating 40 m³-160 m³ of surface oil on Day 2.

The capability to treat the surface area of BAOAC 4 and 5 at full spraying rate (50l/hectare) and the dispersant application volume would treat the available surface volume (0 m³ available at threshold concentration) by Day 3.

6.4.4. Surface Dispersant Application – Control measure options analysis

6.4.4.1. Alternative Control Measures

Alternative Control Measures Considered
Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Dedicated Response Vessel in region (exclusive to Woodside)	The environmental benefits associated with surface dispersant application are described above. The additional environmental benefit obtained from immediate access to this equipment, permitting deployment as soon as conditions became favourable, would result in a negligible environmental benefit (25-40m^3 of oil contacted resulting in approximately 12-26m^3 of oil treated) based on one operation.	Chartering and equipping additional vessels on standby has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated availability of vessel and FWADC resources which have a similar dispersant delivery capacity and are available from Day 2 to treat the spill. The effectiveness of this control (weather dependency, availability and survivability) is rated as very low.	The cost (A$15 m per annum for the PAP) and organisational complexity of employing a dedicated response vessel is considered disproportionate to the minor environmental benefit to be realised by implementing this control.	This option is not adopted as 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

6.4.4.2. 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 SDA 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 application (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 Dampier to coordinate vessel dispersant application	Limited environmental benefit to be gained by training additional personnel.	Current capability meets need. Woodside has a pool of trained, competent offshore responders / team leaders at strategic locations to ensure timely and sustainable response. Additional personnel are available through current contracts with AMOSC and OSRL and agreements with AMSA. Marine standards & guidelines ensure vessel masters are competent for their roles. Regular audits of oil spill response organisations ensure training and competency is maintained.	Minor additional cost regarding training and maintenance of competency.	This option is not adopted as the current capability meets the need.	No

6.4.4.3. Improved Control Measures

Improved Control Measures considered
Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility

Option considered	Environmental consideration	Feasibility	Cost	Assessment conclusions	Implemented
Locate vessel spraying equipment on additional in-field support vessel(s)	This option may achieve minor incremental improvements in surface oil and residual oil volumes similar to those described for integrated fleet vessels. However, given the likely vessel re-supply times involved to/from the offshore spill location, this option is unlikely to realise material environmental benefits additional the capability selected.	Woodside currently has dispersant spray systems pre-located on vessels used in-field during cargo transfer activities. Consideration of equipping additional vessels with similar equipment was made but is not being carried through to implementation.	The option is reasonably practicable and the cost (charter and operational/maintenance costs) is expected to be moderate, particularly when compared with the ability to rapidly commence spraying operations, subject to safety considerations but Woodside considers the existing control measures to be sufficient for the need.	This option is not adopted as the current capability meets the need.	No

6.4.5. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.5. Containment and Recovery – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.5.1. Existing Capability – Containment and Recovery

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours/7 days. 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 6-13: 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 CAR 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	34	45	56	68		473	630	630		2520	2520
E3.2	Predicted oil recovered by containment and recovery (upper) – m^3	68	135	203	270	405	405	405		3915	4725	4725		18,900	18,900
	By Surface Area – km^2														
E3.3	Predicted surface area treated by containment and recovery (lower) – km^2	0	1	1	1	2	2	3		19	25	25		101	101
E3.4	Predicted surface area treated by containment and recovery (upper) – km^2	1	2	3	4	5	5	5		52	63	63		252	252

For E3 – Containment and Recovery, the range of figures shows the predicted recovery rates of surface oil at 50 g/m^2 for the lower figures and 100 g/m^2 for the upper figures using conventional booming systems in a J or U configuration with an encounter rate of 25-50% surface oil meaning 75%-50% of the area within the booming system has surface oil that is not within threshold concentrations <50 g/m^2). All figures rounded to nearest whole m^3 or km^2.

6.5.2. Response Planning: Okha FPSO Facility Operations – loss of well containment (MEE-01)

Deterministic modelling scenarios indicate that first shoreline impact at Barrow Island occurs within 14 days for the loss of well containment scenario (MEE-01). The deterministic model run selected for response planning, however, does not contact Barrow Island and the initial impact is at Ningaloo Coast on Day 75. This model run was selected to demonstrate how a larger scale containment and recovery operation would be developed and implemented.

Modelling results at defined response thresholds (>50 g/m^2) indicate that the subsea release from the loss of well containment scenario (MEE-01) is not expected provide widespread 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.

Modelling predicts there is unlikely to be surface concentrations at BAOAC 5 (greater than 200 g/m^2) with spreading and evaporation decreasing any BAOAC 5 areas to BAOAC 4 (50-200 g/m^2). Due to the weathering and the extensive subsea movement of hydrocarbons from currents at different water depths, there will be likely be sufficient volumes and surface area available for containment and recovery operations throughout the release, but these are expected to be small discrete patches spread over a very large spatial area. Deterministic modelling predicts an initial peak of 197 m^3 in Week 2 with approximately 3 km^2 of surface area at recoverable concentrations. Recoverable concentrations drop back to 0 m^3 during Week 3 and then increase again to 347 m^3 covering an area of 5 km^2 in Week 4. The maximum peak is 900 m^3 occurring in Month 2 with approximately 15 km^2 of surface area at recoverable concentrations.

Table 6-14: Response Planning Okha FPSO Facility Operations loss of well containment (MEE-01) – Release volumes

Okha FPSO Facility Operations loss of well containment (MEE-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		Week 2	Week 3	Week 4		Month 2	Month 3
	Oil on sea surface														
A	Total volume of oil released (subsea) - m^3	2,414	2,414	2,414	2,414	2,414	2,414	2,414		16,898	16,898	16,898		72,420	45,866
B	Cumulative volume released – m^3	2,414	4,828	7,242	9,656	12,070	14,484	16,898		33,796	50,694	67,592		140,012	185,878
C	Total volume of surface oil remaining after weathering (per day) - m^3	369	369	369	369	369	369	369		2,585	2,585	2,585		11,080	7,017

A and B - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge scenario of a loss of well containment of the Okha FPSO Facility Operations well. The total volume for this spill is released over approximately 77 days with a daily flow rate of 2,414 m^3 / day.

C - The Okha FPSO Facility Operations Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 12.0% 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. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers. The whole oil has low asphaltene content (<0.05%), 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 14.5% by mass of the whole oil, with a moderate proportion (7.4%) in the C4-C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolution of a proportion of them into the water.

Table 6-15: Okha FPSO Facility Operations loss of well containment (MEE-01) – Treatable hydrocarbons

Okha FPSO Facility Operations loss of well containment (MEE-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
C	Treatable hydrocarbons following weathering												
C1	Total volume of surface oil >50g/m² – m³	0	0	0	0	0	0	0	197	0	347	900	0
C2	Total surface area >50g/m²– km²	0	0	0	0	0	0	0	3	0	5	15	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 2.3.2.1 regarding surface concentration thresholds, this is the total volume of oil that can be treated by containment and recovery and surface dispersant spraying operations.

C2 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 5 0g/m². This is the total surface area of BAOAC 4 and above that can be treated by containment and recovery and surface dispersant spraying operations.

6.5.2.1. Response Planning Need: Okha FPSO Facility Operations loss of well containment (MEE-01) – Summary

Offshore response operations will always be guided by Operational Monitoring to target the thickest part of the slick, typically BAOAC 5 – continuous true oil colour with a surface oil concentration >200 g/m² and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200 g/m². For a 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.

The response need is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-14 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 6-16: Okha FPSO Facility Operations loss of well containment (MEE-01) – Response Planning Need

Okha FPSO Facility Operations loss of well containment (MEE-01) – Containment and Recovery		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
D	Response Planning Need												
D1	Bonn Agreement Oil Appearance Code (BAOAC) 5 – Continuous True oil colour												
	Surface area of BAOAC 5 (>200 g/m²) – km²	0	0	0	0	0	0	0	0	0	0	0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) – m³	0	0	0	0	0	0	0	0	0	0	0	0
D2													
	Surface area of BAOAC 4 (50-200 g/m²) – km²	0	0	0	0	0	0	0	3	0	5	15	0
	Volume of surface oil BAOAC 4 (50-200 g/m²) – m³	0	0	0	0	0	0	0	197	0	347	900	0
D3	Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen												
	Surface area of BAOAC 3, 2 and 1 (<50 g/m²) – km²	33	3	10	15	57	118	101	210	145	1,159	1,936	517
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m²) - m³	208	41	68	49	361	781	441	1,001	502	7,457	10,634	1,381

6.5.2.2. Containment and Recovery Operations loss of well containment (MEE-01): Surface area and surface volume

Containment and Recovery operations would target discrete patches of oil identified by Monitor and Evaluate activities for a surface release as 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 >50g/m² on each day. Based on volume, this capability required would be approximately 1-3 containment and recovery operations recovering a total of 11.25-67.5 m³ each per day during Week 2, 1-4 containment and recovery operations recovering a total of 11.25-67.5 m³ each per day during Week 4, and 1-3 containment and recovery operations recovering a total of 11.25-67.5 m³ each per day m³ in Month 2. As spreading and weathering occur, there will be limitations on available surface area that can be treated as shown in Section 5.5.

The capability available would be able to cover the surface area of BAOAC 4 from the initial instance of surface thresholds being met in Week 2 with approximately 3 km² of surface area at recoverable concentrations. The total surface volume and surface area of the release and the volume and area of BAOAC 4 decrease rapidly due to weathering, spreading and the effect of wind and current. As expected, the volume and area of sheen (BAOAC 3, 2, 1) increase over this period as BAOAC 4 decreases.

For the purpose of capability demonstration below, Woodside has demonstrated that sufficient capability exists to commence and continue containment and recovery until there are insufficient hydrocarbons for the loss of well containment scenario, at approximately Month 2.

6.5.3. Response Planning: Okha FPSO Facility Operations – vessel cargo tank rupture (MEE-05)

Deterministic modelling scenarios indicate that first shoreline impact at Barrow Island within 7 days (42 m³) for the Okha FPSO Facility Operations cargo tank rupture scenario (MEE-05). The deterministic model run selected for response planning, however, does not contact Barrow Island until approximately Day 12. This model run was selected to demonstrate how a larger scale containment and recovery operation would be developed and implemented.

Modelling results at defined response thresholds (>50 g/m²), where containment and recovery is likely to be effective, indicate that the surface release from the cargo tank rupture scenario (MEE-05) is expected to be available for containment and recovery operations for up to 2 days. From approximately Day 2-3, modelling predicts there are no longer sufficient surface hydrocarbons at threshold concentration to recover due to spreading and weathering. Viscosity alone is unlikely to prevent containment and recovery operations, but very high viscosity combined with low surface concentrations (<50 g/m²) are unlikely to continue to provide a net environmental benefit.

Table 6-17: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Release volumes

Okha FPSO Facility Operations – vessel cargo tank rupture (MEE-05)		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 (surface) - m³	30,302	0	0	0	0	0	0		0	0	0		0	0
B	Total volume of surface oil remaining after weathering (per day) - m³	4,636	0	0	0	0	0	0		0	0	0		0	0

A - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge. The total volume for this spill is 30,302 m³ which is released over approximately 24 hours.

B - The Okha FPSO Facility Operations Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 52.2% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 20.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 12.0% 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. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers. The whole oil has low asphaltene content (<0.05%), 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 14.5% by mass of the whole oil, with a moderate proportion (7.4%) in the C4-C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolution of a proportion of them into the water.

Table 6-18: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Treatable hydrocarbons

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)		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	Total volume of surface oil >50g/m² – m³	2,251	1,633	0	0	0	0	0		0	0	0		0	0
C2	Total surface area >50g/m²– km²	9	15	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 2.3.2.1 regarding surface concentration thresholds, this is the total volume of oil that can be treated by containment and recovery and surface dispersant spraying operations.

C2 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50 g/m². This is the total surface area of BAOAC 5 and 4 and above that can be treated by containment and recovery and surface dispersant spraying operations.

6.5.3.1. Response Planning Need: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – 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 >200g/m² and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200g/m². For a surface release, the thickest oil is typically in the leading edge of the slick, driven by wind and currents. As the spill continues to weather and spread over a number of days and weeks, the surface concentration and surface area of continuous oil colour spreads and reduces to discontinuous true oil colour and finally sheen as shown above.

The response need is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-18 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 6-19: Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Response Planning Need

Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05) – Containment and Recovery		Day	Day	Day	Day	Day	Day	Day		Week	Week	Week		Month	Month
		1	2	3	4	5	6	7		2	3	4		2	3
D	**Response Planning Need**														
D1	**Bonn Agreement Oil Appearance Code (BAOAC) 5 – Continuous True oil colour**														
	Surface area of BAOAC 5 (>200 g/m^2) – km^2	5	0	0	0	0	0	0		0	0	0		0	0
	Volume of surface oil BAOAC 5 (>200 g/m^2) – m^3	1,706	0	0	0	0	0	0		0	0	0		0	0
D2															
	Surface area of BAOAC 4 (50-200 g/m^2) – km^2	4	15	0	0	0	0	0		0	0	0		0	0
	Volume of surface oil BAOAC 4 (50-200 g/m^2) – m^3	545	1633	0	0	0	0	0		0	0	0		0	0
D3	**Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen**														
	Surface area of BAOAC 3, 2 and 1 (<50 g/m^2) – km^2	39	74	109	64	62	67	73		488	102	55		79	0
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m^2) - m^3	383	759	770	329	309	297	288		1,281	149	80		107	0

6.5.3.2. Containment and Recovery Operations vessel cargo tank rupture (MEE-05): Surface area and surface volume

Containment and recovery operations would target discrete patches of oil identified by monitor and evaluate activities for a surface release as 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 majority of the initial surface release (2,251 m^3 available surface oil >50 g/m^2 on Day 1). Based on volume, this capability would be approximately 33-200 containment and recovery operations recovering 11.25-67.5 m^3 each per day. Based on surface area, this capability would need to cover a peak of 15 km^2 on Day 2, decreasing to 0 km^2 (available oil above threshold concentrations) by Day 3. This would require approximately 17-33 containment and recovery operations on Day 2. Recovered quantities are based on daily a recovery rate of 11.25-67.5 m^3 per operation per day. As spreading and weathering occur, there will be limitations on available surface area that can be treated as shown in Section 5.5.

This capability would not cover the surface area of BAOAC 5 on Day 1 (5 km^2) and BAOAC 4 on Days 1 and 2 (4 km^2 and 15 km^2) or the capability to treat the available surface volume within thresholds BAOAC 5 on Day 1 (1706 m^3) and BAOAC 4 on Days 1 and 2 (545 m^3 and 1633 m^3). This level of capability does not exist in Australia. Due to spreading and weathering these surface concentrations drop below recoverable thresholds (>50 g/m^2) on Day 3.

Woodside has considered pre-positioning additional resources and including additional capability on vessels and shore locations, that would allow for the treatment of some additional surface hydrocarbons on Days 1 and 2, thereby potentially limiting the migration of surface hydrocarbons to RPA locations. These options are considered below with selected control measures implemented to improve the capability.

Implementing further capability is not expected to provide a significant environmental benefit as only a minor portion of the available surface hydrocarbons would be treated using this technique.

6.5.4. Containment and Recovery – Control Measure Options Analysis

6.5.4.1. 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 – 11.25-67.5 m^3 of oil recovered per operating unit per day.	Chartering and equipping additional vessels on standby has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated effectiveness of dispersant operations to treat the spill which are available from Day 2. The effectiveness of this control (encounter rate, weather dependency, availability) is rated as very low.	The cost (A$15 m per annum for the PAP) and organisational complexity of employing a dedicated response vessel is considered disproportionate to the insignificant environmental benefit to be realised by implementing this control.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Dedicated Response Vessel in region (shared resource)	The environmental benefit would be similar to that described above for Woodside integrated fleet vessels.	Additional containment and recovery resources and capability can be contracted should the need arise.	The cost and complexity of implementing and maintain this alternative control measure is considered high given the predicted effectiveness. Even with consideration of shared costs, the minor benefit of this control measure does not justify the cost.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Regional oil spill response contractor	This option may achieve minor incremental improvements in surface oil and residual oil volumes similar to those described for integrated fleet vessels. However, given the likely vessel transit times involved to/from the offshore spill location, this option is unlikely to realise material environmental benefits additional the capability selected.	No current private response contracting capability exists that would significantly improve response timing or effectiveness in the Dampier or Exmouth regions.	N/A – not currently feasible	This option is not adopted as it is not currently feasible.	No

6.5.4.2. Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Train additional Woodside personnel in Dampier to coordinate containment and recovery operations	Limited environmental benefit to be gained by training additional personnel as the number of operations will be governed by the availability of response vessels.	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

6.5.4.3. Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Prioritise rapid sweep systems (NOFI Buster series, Desmi Speed Sweep, etc.) for mobilisation from service providers	The environmental benefit of containment and recovery as a response strategy is minor. This response strategy is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore, but there is expected to be a minor environmental benefit since each rapid sweep containment and recovery operation could remove an additional 10-45 m^3 per operation per day.	Rapid sweep systems allow containment and recovery operations to be undertaken at speeds of up to 3 knots. This allows for greater encounter rates and surface coverage. AMOSC has recently purchased a Speed Sweep system and a number of NOFI systems are available through Mutual Aid arrangements.	Additional costs for prioritising rapid sweep systems are negligible	Although containment and recovery remains a low-efficiency response technique, this control measure is adopted as the costs and complexity are not considered disproportionate to any	Yes

				environmental benefit that might be realised.	
Prioritise active booming systems (Ro-skim, etc.) for mobilisation from service providers	The environmental benefit of containment and recovery as a response strategy is minor. This response strategy is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore, but there is expected to be a minor environmental benefit since each rapid sweep containment and recovery operation could remove an additional 10-45 m^3 per operation per day.	Active booming systems allow containment and recovery operations without the need for an additional skimming system. This allows for greater effectiveness and continued skimming operations. Active booming systems are available through OSRL and Mutual Aid arrangements and would be prioritised for mobilisation.	Additional costs for prioritising active booming systems are negligible	Although containment and recovery remains a low-efficiency response technique, this control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes
Pre-position additional containment and recovery equipment (Exmouth)	It is unlikely that faster mobilisation and deployment from Exmouth would significantly increase response effectiveness or removal of oil to create an increased environmental benefit	Facilities at Exmouth are currently limited by tides and draft for the loading and unloading of vessels with heavy plant and equipment. Access to the Navy Pier to provide an additional loading location is subject to Defence Force approval and cannot be relied upon for rapid approval in the event of an oil spill.	Limited additional cost considerations.	This option is not adopted as the complexity is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No
Re-locate containment and recovery equipment on in-field vessels	The additional environmental benefit obtained from faster mobilisation and deployment would be limited by safety considerations during the initial period following the release. Once operations were considered safe, the vessels would increase recovery capacity to 23-90 m^3/day per operation. The limited oil treatment of containment and recovery and expected effectiveness of dispersant application from vessels indicates the preference would be for greater SDA 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

6.5.5. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - Prioritise rapid sweep systems (NOFI Buster series, Desmi Speed Sweep, etc.) for mobilisation from service providers
  - Prioritise active booming systems (Ro-skim, etc.) for mobilisation from service providers

6.6. Shoreline Protection & Deflection - ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.6.1. Existing Capability – Shoreline Protection and Deflection

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.6.2. Response Planning: Okha FPSO Facility 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 by Day 1 if required (1 operation available). Deterministic modelling scenarios indicate that first shoreline impact at Barrow Island within 7 days for the vessel cargo tank rupture scenario (MEE-05) and at Barrow Island within 14 days for the loss of well containment scenario (MEE-01). The deterministic model run selected for response planning, however, does not contact Barrow Island until approximately Day 12. This model run was selected to demonstrate how a larger scale shoreline protection and deflection operation would be developed and implemented. Given shoreline contact at RPAs is not predicted until Day 7 at Barrow Island, the existing capability is considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by predictive modelling, direct observation/surveillance and remote sensing methods (OM01, OM02 and OM03) employed from the outset of a spill to track the oil and assess receptors at risk. This will then trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04). OM04 would only be undertaken in liaison with WA DoT.

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 6-20 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 6-20: 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) m³													
A1	Number of RPAs contacted (> 100g/m²) - Okha FPSO Facility Operations LOWC (MEE-01)	0	0	0	0	0	0	0	0	0	0	0	4	1
A2	Number of RPAs contacted (> 100g/m²) - Okha FPSO Facility Operations vessel cargo tank rupture (MEE-05)	0	0	0	0	0	0	0	3	1	0	2	0	0
B1	SPD operations available – per day (lower)	0	1	1	2	2	4	6	70	70	70	330	330	0
B2	SPD operations available – per day (upper)	1	2	3	4	6	8	10	84	84	84	336	336	1
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 100g/m²

B1 and B2 – the upper and lower number of shoreline protection and deflection operations available (based on response planning assumptions in Section 5.6),

C1 and C2 – the gap between the upper and lower number of shoreline protection and deflection operations required in A1 and A2 compared to the operations available in B1 and B2

Table 6-21: RPAs for Okha FPSO Facility Operations Facility Operations

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days [14]	Maximum shoreline accumulation (above 100g/m^2) in m^3 [15]	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3
			Scenario 1 (MEE-01) – Model 23, Q2		Scenario 5 (MEE-05) – Model 32, Q2	
Ningaloo Coast North and World Heritage Area	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	75 days (20 m^3)	30 m^3 (day 77)	40 days (0.3 m^3)	1.1 m^3 (day 44)
Montebello Islands and State Marine Park	State Marine Park AMP	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN II and IV – Recreational Use Zone IUCN II – Marine National Park Zone	No contact	No contact	11 days (71 m^3)	113 m^3 (day 14)
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	No contact	No contact	12 days (4 m^3)	63 m^3 (day 15)
Lowendal Islands	State Marine Park	IUCN VI – Multiple Use Zone	No contact	No contact	12 days (1 m^3)	3 m^3 (day 16)
Pi bara Islands – Southern Islands Group	State Marine Park Australian Marine Park	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	76 days (1.4 m^3)	66 m^3 (day 84)	19 days (0.7 m^3)	36 m^3 (day 40)

[14] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[15] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days (14)	Maximum shoreline accumulation (above 100g/m^2) in m^3 (15)	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3
			Scenario 1 (MEE-01) – Model 23, Q2		Scenario 5 (MEE-05) – Model 32, Q2	
Shark Bay World Heritage Area	State Marine Park Australian Marine Park World Heritage Area	N/A	99 days (0.2 m^3)	0.2 m^3 (99 days)	No contact	No contact
Exmouth Gulf West	N/A	N/A	83 days (0.08 m^3)	0.2 m^3 (87 days)	No contact	No contact
Muiron Islands Marine Management Area and World Heritage Area	Muiron Islands Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	75 days (0.3 m^3)	41 m^3 (99 days)	40 days (3 m^3)	4 m^3 (day 45)

Table 6-22: Indicative Tactical Response Plan, aims and methods for RPAs contacted within 14 days

Tactical Response Plan	Response aims and methods
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. **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.
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.

Pre-emptive mobilisation of equipment and personnel would commence as soon as practicable prior to oil contact. Additional resources would be mobilised depending on the scale of the event to increase the length or number of shorelines being protected.

A shoreline protection and deflection response would be launched and additional TRPs drafted only when operational monitoring (OM02 and OM03) and modelling (OM01) indicate that contact could occur at RPA(s) within 14 days. The outputs from the monitoring will inform the need for and/or direct any additional response techniques and, additionally, if/when the spill enters State Waters and control of the incident passes to WA DoT.

6.6.3. Shoreline Protection and Deflection – Control Measure Options Analysis

6.6.3.1. Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Pre-position equipment at Response Protection Areas (RPAs)	Additional environmental benefit of having equipment prepositioned is considered minor. Equipment is currently available to protect RPAs and additional shorelines, within estimated minimum times until shoreline contact at RPAs, enabling mobilisation of the selected delivery options.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost to preposition protection/ deflection packages at each site of potential impact would be approx. A$6100 per package per day.	This option is not adopted as the existing capability meets the need.	No

6.6.3.2. Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Supplemented stockpiles of equipment in Exmouth to protect additional shorelines	Additional equipment would increase the number of receptor areas that could be protected from hydrocarbon contact. However, current availability of personnel and equipment is capable of protecting up to 30km of shoreline, commensurate with the scale and progressive nature of shoreline impact. Additional stocks would be made available from international sources if long term up scaling were necessary. A reduction in environmental consequence from a 'B' rating (serious long-term impacts) is unlikely to be realised as a result of having more equipment available locally.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost for purchase supplemental protection and deflection equipment would be approx. A$455,000 per package.	This option is not adopted as the existing capability meets the need.	No
Additional trained personnel	The level of training and competency of the response personnel ensures the shoreline protection and deflection operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted OSRO's (OSRL/AMOSC) to manage other responders. Response personnel are trained and exercised regularly in shoreline response techniques and methods. All personnel involved in a response will receive a full operational/safety brief prior to commencing operations.	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.6.3.3. Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict shoreline contact at Barrow Island until approximately 7 days (MEE-05) or 14 days (MEE-01), Woodside considers that there is sufficient time for deployment of protection and deflection operations prior to impact.	Response teams, trained personnel, contracted oil spill response service providers, government agencies and the associated mitigation equipment required to enact an initial protection and deflection response will be available for mobilisation within 24-48 hrs of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within days. Hydrocarbons are predicted to strand after a period of approximately 7 days (MEE-05) or 14 days (MEE-01) therefore allowing enough time to re-locate existing equipment, personnel and other resources to the most appropriate areas.	The cost of establishing a local stockpile of new mitigation equipment (including protection and deflection boom) closer to the expected hydrocarbon stranding areas is not commensurate with the need.	This option is not adopted as the existing capability meets the need.	No

6.6.4. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.7. Shoreline Cleanup – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.7.1. Existing Capability – Shoreline Clean-up

Woodside's 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: Okha FPSO Facility 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. Woodside's capability can cover all required shoreline clean-up operations for the PAP.

Modelling predicts fastest shoreline contact at Barrow Island from day 7 (42 m^3) for the vessel cargo tank rupture scenario (MEE-05). The deterministic model run selected for response planning, however, does not contact Barrow Island until approximately Day 12. This model run was selected to demonstrate how a larger scale shoreline response operation would be developed and implemented. The largest volumes ashore are at Montebello Islands and Montebello Islands State Marine Park with approximately 110 m^3 predicted on Day 11 (MEE-05). These volumes assume no treatment of floating surface oil by containment and recovery or surface dispersant application prior to contact so are considered very conservative. 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.

These figures have been combined into a single response planning need scenario that provides a worst-case scenario for planning purposes as outlined below. Given all other shoreline contact scenarios identified from deterministic modelling are longer time frames and lesser volumes, demonstration of capability against this need will ensure Woodside can meet requirements for any other outcome. Woodside is satisfied that the current capability is managing risks and impacts to ALARP.

Due to the time of predicted contact for shoreline clean-up, and deterministic modelling predicting ongoing stranding after this peak, this response may not be as time critical compared to other response techniques and the scale will depend on the success of other techniques preventing oiling occurring. Further, the potential scale and remoteness of a response coupled with the uncertainty of which locations will be affected precludes the stockpiling or prepositioning of equipment specific to shorelines. The most significant constraint is accommodation and transport of personnel in the Dampier region to undertake clean-up operations and to manage wastes generated during the response effort. From previous assessment of facilities in the Dampier region, Woodside estimates that current accommodation can cater for a range of 500-700 personnel per day.

Woodside has identified several options which could be mobilised to achieve defined response objectives. Evaluation considers the benefit in terms of the time to respond and the scale of response made possible by each option. The evaluation of possible control measures is summarised in Section 6.7.3

Table 6-23: Response Planning – Shoreline Cleanup

	Shoreline Cleanup (Phase 2)	Day	Day	Day	Day	Day	Day	Day	Week	Week	Week	Month	Month	Month
		1	2	3	4	5	6	7	2	3	4	2	3	4
	Oil on shoreline (from deterministic modelling) m^3													
	Shoreline accumulation (above 100g/m^2) - m^3	0	0	0	0	0	0	0	113	66	0	41	0	0
	Oil remaining following response operations - m^3	0	0	0	0	0	0	0	0	45	0	0	-25	0
A	Capability Required (number of operations)													
A1	Shoreline clean-up operations required (lower)	0	0	0	0	0	0	0	11	11	0	4	-2	0
A2	Shoreline clean-up operations required (upper)	0	0	0	0	0	0	0	16	16	0	6	-4	0
B	Capability Available (number of operations)													
B1	Shoreline clean-up operations available - Stage 2 - Manual (lower)	0	1	3	5	8	12	15	105	105	105	560	560	560
B2	Shoreline clean-up operations available - Stage 2 - Manual (upper)	0	2	5	8	10	15	20	140	140	140	560	560	560
C	Capability Gap													
C1	Shoreline clean-up operations gap (lower)	0	0	0	0	0	0	0	0	0	0	0	0	0
C2	Shoreline clean-up operations gap (upper)	0	0	0	0	0	0	0	0	0	0	0	0	0

A1 and A2 – the number of Shoreline clean-up operations required based on the hydrocarbon volumes ashore above 100g/m^2

B1 and B2 – the upper and lower number of shoreline clean-up operations available (based on response planning assumptions in Section 5.7),

C1 and C2 – the gap between the upper and lower number of shoreline clean-up operations required in A1 and A2 compared to the operations available in B1 and B2

Table 6-24: RPAs for Okha FPSO Facility Operations Facility Operations

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m²) in days [16]	Maximum shoreline accumulation (above 100g/m²) in m³ [17]	Minimum time to shoreline contact (above 100g/m²) in days	Maximum shoreline accumulation (above 100g/m²) in m³
			Scenario 1 (MEE-01) – Model 23, Q2		Scenario 5 (MEE-05) – Model 32, Q2	
Ningaloo Coast North and World Heritage Area	State Marine Park Australian Marine Park World Heritage Area	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	75 days (20 m³)	30 m³ (day 77)	40 days (0.3 m³)	1.1 m³ (day 44)
Montebello Islands and State Marine Park	State Marine Park AMP	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN II and IV – Recreational Use Zone IUCN II – Marine National Park Zone	No contact	No contact	11 days (71 m³)	113 m³ (day 14)
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	No contact	No contact	12 days (4 m³)	63 m³ (day 15)
Lowendal Islands	State Marine Park	IUCN VI – Multiple Use Zone	No contact	No contact	12 days (1 m³)	3 m³ (day 16)
Pi bara Islands – Southern Islands Group	State Marine Park Australian Marine Park	IUCN IV – Recreational Use Zone (AMP) IUCN II – Marine National Park Zone	76 days (1.4 m³)	66 m³ (day 84)	19 days (0.7 m³)	36 m³ (day 40)

[16] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[17] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above $100g/m^2$) in days (16)	Maximum shoreline accumulation (above $100g/m^2$) in m^3 (17)	Minimum time to shoreline contact (above $100g/m^2$) in days	Maximum shoreline accumulation (above $100g/m^2$) in m^3
			Scenario 1 (MEE-01) – Model 23, Q2		**Scenario 5 (MEE-05) – Model 32, Q2**	
Shark Bay World Heritage Area	State Marine Park Australian Marine Park World Heritage Area	N/A	99 days (0.2 m^3)	0.2 m^3 (99 days)	No contact	No contact
Exmouth Gulf West	N/A	N/A	83 days (0.08 m^3)	0.2 m^3 (87 days)	No contact	No contact
Muiron Islands Marine Management Area and World Heritage Area	Muiron Islands Marine Management Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	75 days (0.3 m^3)	41 m^3 (99 days)	40 days (3 m^3)	4 m^3 (day 45)

6.7.3. Shoreline Clean-up – Control measure options analysis

6.7.3.1. Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.7.3.2. Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional trained personnel available	The level of training and competency of the response personnel ensures the shoreline clean-up operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted 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
Additional trained personnel deployed	Maintaining a span of control of 200 competent personnel is deemed manageable and appropriate for this activity. Additional personnel conducting clean-up activities may be able to complete the clean-up in a shorter timeframe, but modelling predicts ongoing stranding of hydrocarbons over a period of weeks. Managing a smaller, targeted response is expected to achieve an environmental benefit through ensuring the shoreline clean-up response is suitable and scalable for the shoreline substrate and sensitivity type. This will ensure there is no increased impact from the shoreline clean-up through the presence of unnecessary personnel and equipment.	The figure of 200 personnel is broken down to include on 1-2 x Trained Supervisors managing 8-10 personnel/labour hire responders. This allows for multiple operational teams to operate along the extended shoreline at different locations. Typically, an additional 30-50% of the tactical workforce is required to support ongoing operations including On-Scene control, logistics, safety/medical/welfare and transport. Personnel on site will include members with the appropriate specialties to ensure an efficient shoreline clean-up. Additional personnel are available through existing contracts with oil spill response organisations, labour hire organisations and environmental panel contractors	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.7.3.3. Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict shoreline contact at Barrow Island until approximately 7 days (MEE-05) or 14 days (MEE-01), Woodside considers that there is sufficient time for deployment of shoreline clean-up operations prior to impact.	Response teams, trained personnel, contracted oil spill response service providers, government agencies and the associated mitigation equipment required to enact an initial protection and deflection response will be available for mobilisation within 24-48hrs of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within days. Hydrocarbons are predicted to strand after a period of approximately 7 days (MEE-05) or 14 days (MEE-01) therefore allowing enough time to re-locate existing equipment, personnel and other resources to the most appropriate areas.	The cost of establishing a local stockpile of new shoreline clean-up equipment closer to the expected hydrocarbon stranding areas is not commensurate with the need.	This option is not adopted as the existing capability meets the need.	No

6.7.4. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.8. 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.

6.8.1. Existing Capability – Waste Management

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. Waste Management – Control Measure Options Analysis

6.8.2.1. Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.8.2.2. Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Increased waste storage capability	The procurement of waste storage equipment options on the day of the event will allow immediate response and storage of collected waste. The environmental benefit of immediate waste storage is to reduce ecological consequence by safely securing waste, allowing continuous response operations to occur.	Access to Veolia's storage options provides the resources required to store and transport sufficient waste to meet the need. Access to waste contractors existing facilities enables waste to be stockpiled and gradually processed within the regional waste handling facilities. Additional temporary storage equipment is available through existing contract and arrangements with OSRL. Existing arrangements meet identified need for the PAP.	Cost for increased waste disposal capability would be approx. A$1300 per m^3. Cost for increased onshore temporary waste storage capability would be approx. A$40 per unit per day.	This option is not adopted as the existing capability meets the need.	No

6.8.2.3. Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster 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 Dampier 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

6.8.3. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.9. 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.

6.9.1. Existing Capability – Wildlife Response

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.

6.9.2. Oiled Wildlife Response – 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
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

6.9.2.2. 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
Additional wildlife treatment systems	The selected delivery options provide access to call-off contracts with selected specialist providers. The agreements ensure that these resources can be mobilised to meet the required response objectives, commensurate with the progressive nature of environmental impact and the time available to monitor hydrocarbon plume trajectories. Provides response equipment and personnel by Day 3. The additional cost in having a dedicated oiled wildlife response (equipment and personnel) in place is disproportionate to environmental benefit. These selected delivery options provide capacity to carry out an oiled wildlife response if contact is predicted; and to scale up the response if required to treat widespread contamination. Current capability meets the needs required and there is no additional environmental benefit in adopting the improvements.	Although hydrocarbon contact above threshold concentrations with offshore waters is expected from Day 1, 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. Additionally, the remote offshore location of the release site with contact of shoreline receptors predicted on Day 7 provides sufficient opportunity for the ongoing monitoring and surveillance operations to inform the scale of the response. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. Oiled wildlife response capacity would be addressed for open Commonwealth waters through the AMOSC arrangements, as informed by operational monitoring. The cost and organisational complexity of this approach is moderate, and the overall delivery effectiveness is high.	Additional wildlife response resources could total A$1700 per operational site per day.	This option is not adopted as the existing capability meets the need.	No
Additional trained wildlife responders	Current numbers meet the needs required and additional personnel are available through existing contracts with oil spill response organisations and environmental panel contractors. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. The potential environmental benefit of training additional personnel is expected to be low.	The capability provides the capacity to treat approximately 600 wildlife units (primarily avian fauna) 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 fauna. 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

6.9.2.3. 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 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. The cost of having dedicated equipment and personnel available to respond faster is considered disproportionate to the environmental benefit.	Pre-positioning vessels or equipment would reduce mobilisation time for oiled wildlife response activities. However, given the effectiveness of an oiled wildlife response is expected to be low, an earlier response would provide a marginal increase in environmental benefit. The selected delivery options provide the capacity to mobilise an oiled wildlife response capable of treating up to 600 wildlife from at least Day 6 and exceeds the estimated Level four 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.	This option is not adopted as the existing capability meets the need.	No

6.9.3. Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.10. Scientific Monitoring – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.10.1. Existing Capability – Scientific Monitoring

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.10.2. Scientific Monitoring – 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

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 over to the East coast. 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 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 by a limited amount (days) with associated high costs of maintaining capability and no additional 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 Employing a dedicated response vessel is considered to have a negligible net benefit.

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

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.

6.10.2.3. Improved Control Measures

No reasonably practicable improved Control Measures identified.

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
  - Determine baseline data needs and activate SMPs for any identified PBAs in the event of an unplanned hydrocarbon release
- Improved
  - None selected

6.10.4. Operational Plan

Key actions from the Scientific Monitoring Program Operational Plan for implementing the response are outlined in Table 6-25.

Table 6-25: Scientific monitoring program operational plan actions

Responsibility	Action
Activation	
Perth ICC Planning (ICC Planning – Environment Unit)	Mobilise Chief Environmental Scientist/SMP Lead/Manager and SMP Coordinator to the ICC Planning function.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager and SMP Coordinator)	Constantly assess all outputs from OM01, OM02 and OM03 (**Section 5 and** Annex B) to determine receptor locations and receptors at risk. Confirm sensitive receptors l kely 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 Lean/Manager and SMP Coordinator)	SMP co-ordinator stand up SMP Standby contractor. Stand up subject matter experts, if required.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP Standby contractor)	Establish if, and where, pre-contact baseline data acquisition is required. Determine practicable baseline acquisition program based on predicted timescales to contact and anticipated SMP mobilisation times. Determine scope for preliminary post-contact surveys during the Response Phase. Determine which SMP activities are required at each location based on the identified receptor sensitivities.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP Standby contractor)	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 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.

Responsibility	Action
(SMP Lead/Manager, SMP Coordinator, SMP Standby contractor)	Update the IAP.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP Standby contractor)	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 contractor, 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 contractor)	Confirm communications procedures between Woodside SMP team, SMP standby contractor, 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 contractor 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).

6.10.5. ALARP and Acceptability Summary

Table 6-26: ALARP and Acceptability Summary

<table>
<tr><th colspan="3">ALARP and Acceptability Summary</th></tr>
<tr><td colspan="3">Scientific Monitoring</td></tr>
<tr><td rowspan="4">ALARP Summary</td><td>X</td><td>All known reasonably practicable control measures have been adopted</td></tr>
<tr><td></td><td>No additional, alternative and improved control measures would provide further benefit</td></tr>
<tr><td></td><td>No reasonably practical additional, alternative, and/or improved control measure exists</td></tr>
<tr><td colspan="2">The resulting scientific monitoring capability has been assessed against the worst-case credible spill scenarios. The range of strategies provide an ongoing approach to monitoring operations to assess and evaluate the scale and extent of impacts.

All known reasonably practicable control measures have been adopted with the cost and organisational complexity of these options determined to be Moderate and the overall delivery effectiveness considered Medium. The SMP's main objectives can be met, with the addition of alternative control measures to provide further benefit.</td></tr>
<tr><td>Acceptability Summary</td><td colspan="2">• The control measures selected for implementation manage the potential impacts and risks to ALARP.
• In the event of a hydrocarbon spill for the PAP, the control measures selected, meet or exceed the requirements of Woodside Management System and industry best-practice.
• Throughout the PAP, relevant Australian standards and codes of practice will be followed to evaluate the impacts from a loss of well containment.
• The level of impact and risk to the environment has been considered with regard to the principles of Environmentally Sustainable Development (ESD); and risks and impacts from a range of identified scenarios were assessed in detail. The control measures described consider the conservation of biological and ecological diversity, through both the selection of control measures and the management of their performance. The control measures have been developed to account for the worst-case credible case scenarios, and uncertainty has not been used as a reason for postponing control measures.</td></tr>
<tr><td colspan="3">On the basis from the impact assessment above and in Section 6 of the EP Woodside considers the adopted controls discussed manage the impacts and risks associated with implementing scientific monitoring activities to a level that is ALARP and acceptable.</td></tr>
</table>

7 ENVIRONMENTAL RISK ASSESSMENT OF SELECTED RESPONSE TECHNIQUES

The implementation of response techniques may modify the impacts and risks identified in the EP and response activities can introduce additional impacts and risks from response operations themselves. Therefore, it is necessary to complete an assessment to ensure these impacts and risks have been considered and specific measures are put in place to continually review and manage these further impacts and risks to ALARP and Acceptable levels. A simplified assessment process has been used to complete this task which covers the identification, analysis, evaluation and treatment of impacts and risks introduced by responding to the event.

7.1. Identification of impacts and risks from implementing response techniques

Each of the control measures can modify the impacts and risks identified in the EP. These impacts and risks have been previously assessed within the scope of the EP. Refer to the EP for details regarding how these risks are being managed. They are not discussed further in this document.

- Atmospheric emissions
- Routine and non-routine discharges
- Physical presence, proximity to other vessels (shipping and fisheries)
- Routine acoustic emissions vessels
- Lighting for night work/navigational safety
- Invasive marine species
- Collision with marine fauna
- Disturbance to Seabed

Additional impacts and risks associated with the control measures not included within the scope of the EP include:

- Vessel operations and anchoring
- Presence of personnel on the shoreline
- Increase in entrained hydrocarbons
- Toxicity of dispersant
- Human presence (manual cleaning)
- Vegetation cutting
- Additional stress or injury caused to wildlife
- Secondary contamination from the management of waste

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 response					✓	✓	
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 seasnakes 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 20m, through wave and wind energy. These elevated concentrations of dispersed hydrocarbons within the upper layer of the water column are rapidly diluted through vertical and horizontal mixing. The application of surface dispersants may result in a greater risk that water column and subtidal habitats could be exposed to elevated concentrations of dispersed hydrocarbons.

Toxicity of dispersants

The evaluation of the potential impacts to the receiving environment needs to consider not only the redistribution of hydrocarbons into the water column, but also the potential toxic nature of the dispersant applied and the toxicity effects of dispersed hydrocarbons.

The potential toxicity to the marine environment can be from the chemical/dispersant itself but also chemical dispersion of hydrocarbon can increase the concentration of toxic hydrocarbon compounds in the water column (Anderson et al 2014). Subtidal habitats and communities such as coral reefs, seagrass meadows, plankton, fish, known spawning grounds and periods of increased reproductive outputs (early life stages of fish and invertebrates i.e. meroplankton) are susceptible to toxic effects of chemically dispersed hydrocarbons.

Presence of personnel on the shoreline

Presence of personnel on the shoreline during shoreline operations could potentially result in disturbance to wildlife and habitats. During the implementation of response techniques, it is possible that personnel may have minimal, localised impacts on habitats, wildlife and coastlines. The impacts associated with human presence on shorelines during shoreline surveys and response operations may include:

- Damage to vegetation/habitat 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); and
- 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; and
- 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 27.5)
- Trained unit leader's brief personnel of the risks prior to operations (PS 27.6)

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 27.4)

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 scenario 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.

Term	Description / Definition
Receptor Sensitivities	This is a classification scheme to categorise receptor sensitivity to an oil spill. The Environmental Sensitivity Index (ESI) is a numerical classification of the relative sensitivity of a particular environment (particularly different shoreline types) to an oil spill. Refer to the Woodside OPEA for more details.
Regulator	NOPSEMA are the Environment Regulator under the Environment Regulations.
Reliability	The probability that at any point in time a control measure will operate correctly for a further specified length of time.
Response technique	The key priorities and objectives to be achieved by the response plan Measures taken in response to an event to reduce or prevent adverse consequences.
Survivability	Whether or not a control measure is able to survive a potentially damaging event is relevant for all control measures that are required to function after an incident has occurred.
Threshold	Hydrocarbon threshold concentrations applied to the risk assessment to evaluate hydrocarbon spills.
Zone of Application	The zone in which Woodside may elect to apply dispersant. The zone is determined based on a range of considerations, such as hydrocarbon characteristics, weathering and metocean conditions. The zone is a key consideration in the Net Environmental Benefit Analysis for dispersant use.

11.2. Abbreviations

Abbreviation	Meaning
AIIMS	Australasian Inter-Service Incident Management System
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
BSEE	Bureau of Safety and Environmental Enforcement
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)
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
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
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
NEBA	Net Environmental Benefit Analysis
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
OILMAP	Oil Spill Model and Response System

Abbreviation	Meaning
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
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 Cossack Light Crude (MEE-01), a surface hydrocarbon release due to a support vessel tank rupture of marine diesel (MEE-03) and a surface vessel cargo tank rupture scenario of Cossack Light Crude (MEE-05). The complete list of potential receptor locations within the EMBA within the PAP is included in Section 6 of the EP.

The locations utilised for the NEBA were limited to the identified RPAs of the PAP identified from modelling (see Section 3 for outline of selection). These include receptors which have potential for the following:

- Surface contact (>50 g/m^2)
- Shoreline accumulation (100g/m^2) at any time

The detailed NEBA assessment outcomes are shown below. The Okha FPSO Operations Preoperational NEBA assessments contain the full assessments.

Table A-1: NEBA assessment technique recommendations for Cossack Light Crude from a loss of well containment (MEE-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
Ningaloo Coast World Heritage Area	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Montebello Islands and State Marine Park	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Barrow Island	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Southern Pilbara - Islands and Shoreline	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Muiron Islands Marine Management Area and World Heritage Area	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Commonwealth waters	Yes	Yes	N/A	Yes	Yes	No	No	Yes	No	No	No	No	Yes
Shark Bay Open Ocean and World Heritage Area	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Exmouth Gulf West	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Lowendal Islands	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes

Overall assessment

Sensitive receptor (Sites identified in EP)	Monitor and Evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and Recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response
Is this response Practicable?	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes

Table A-2: NEBA assessment technique recommendations for surface hydrocarbon release due to a support vessel tank rupture of marine diesel (MEE-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
Commonwealth waters	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	No	No	No	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	N/A	Yes	No	No	No	No	No	No	No	No	No	Yes

Table A-3: NEBA assessment technique recommendations for Cossack Light Crude from a vessel cargo tank rupture (MEE-05)

Receptor	Monitor and Evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and Recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response
Ningaloo Coast North and World Heritage Area	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Montebello Islands and State Marine Park	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Barrow Island	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Lowendal Islands	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Southern Pilbara - Islands and Shoreline	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Muiron Islands World Heritage Area and State Marine Park	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Commonwealth waters	Yes	N/A	Yes	No	Yes	No	No	Yes	No	No	No	No	Yes

Overall assessment

Sensitive receptor (Sites identified in EP)	Monitor and Evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and Recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response
Is this response Practicable?	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	N/A	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes

NEBA Impact Ranking Classification Guidance

To reduce variability between assessments, the following ranking descriptions have been devised to guide the workshop process:

<table>
<tr><th></th><th></th><th></th><th>Degree of impact</th><th>Potential duration of impact</th><th>Equivalent Woodside Corporate Risk Matrix Consequence Level</th></tr>
<tr><td rowspan="3">Positive</td><td>3P</td><td>Major</td><td>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.</td><td>Decrease in duration of impact by > 5 years</td><td>N/A</td></tr>
<tr><td>2P</td><td>Moderate</td><td>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.</td><td>Decrease in duration of impact by 1–5 years</td><td>N/A</td></tr>
<tr><td>1P</td><td>Minor</td><td>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.</td><td>Decrease in duration of impact by several seasons (< 1 year)</td><td>N/A</td></tr>
<tr><td></td><td>0</td><td>Non-mitigated spill impact</td><td>No detectable difference to unmitigated spill scenario.</td><td></td><td></td></tr>
<tr><td rowspan="3">Negative</td><td>1N</td><td>Minor</td><td>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]</td><td>Increase in duration of impact by several seasons (< 1 year)</td><td>Increase in risk by one sub-category, without changing category (e.g. Minor (E) to Minor (D))</td></tr>
<tr><td>2N</td><td>Moderate</td><td>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.</td><td>Increase in duration of impact by 1–5 years</td><td>Increase in risk by one category (e.g. Minor (D) to Moderate (C or B))</td></tr>
<tr><td>3N</td><td>Major</td><td>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.</td><td>Increase in duration of impact by > 5 years or unrecoverable</td><td>Increase in risk by two categories (e.g. Minor (E) to Major (A))</td></tr>
</table>

NOTE: the maximum likely impact should be considered; for example, if a spill were to directly impact the behaviour that results in an impact to reproduction and/or the breeding population (such as fish failing to aggregate to spawn), then the score should be a 2 or 3 rather than a 1. Similarly, if a change in behaviour resulted in an increased risk of mortality of a population, then it should be scored as a 2 or 3.

ANNEX B: OPERATIONAL MONITORING ACTIVATION AND TERMINATION CRITERIA

Table B-1: Operational monitoring objectives, triggers and termination criteria

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 1 (OM01) Predictive Modelling of Hydrocarbons to Assess Resources at Risk	OM01 focuses on the conditions that have prevailed since a spill commenced, as well as those that are forecasted in the short term (1–3 days ahead) and longer term. OM01 utilises computer-based forecasting methods to predict hydrocarbon spill movement and guide the management and execution of spill response operations to maximise the protection of environmental resources at risk. The objectives of OM01 are to: • Provide forecasting of the movement and weathering of spilled hydrocarbons • Identify resources that are potentially at risk of contamination • Provide simulations showing the outcome of alternative response options (booming patterns etc.) to inform on-going Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP	OM01 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM01 are: • The hydrocarbon discharge has ceased and no further surface oil is visible • Response activities have ceased • Hydrocarbon spill modelling (as verified by OM02 surveillance observations) predicts no additional natural resources will be impacted

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 2 (OM02) Surveillance and reconnaissance to detect hydrocarbons and resources at risk	OM02 aims to provide regular, on-going hydrocarbon spill surveillance throughout a broad region, in the event of a spill. The objectives of OM02 are: • Verify spill modelling results and recal brate spill trajectory models (OM01) • Understand the behaviour, weathering and fate of surface hydrocarbons • Identify environmental receptors and locations at risk or contaminated by hydrocarbons • Inform ongoing Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP • To aid in the subsequent assessment of the short- to long-term impacts and/or recovery of natural resources (assessed in SMPs) by ensuring that the visible cause and effect relationships between the hydrocarbon spill and its impacts to natural resources have been observed and recorded during the operational phase.	OM02 will be triggered immediately following a level 2/3 hydrocarbon spill.	The termination triggers for the OM02 are: • 72 hours has elapsed since the last confirmed observation of surface hydrocarbons • Latest hydrocarbon spill modelling results (OM01) do not predict surface exposures at visible levels

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 3 (OM03) Monitoring of hydrocarbon presence, properties, behaviour and weathering in water	OM03 will measure surface, entrained and dissolved hydrocarbons in the water column to inform decision-making for spill response activities. The specific objectives of OM03 are as follows: • Detect and monitor for the presence, quantity, properties, behaviour and weathering of surface, entrained and dissolved hydrocarbons • Verify predictions made by OM01 and observations made by OM02 about the presence and extent of hydrocarbon contamination Data collected in OM03 will also be used for the purpose of longer-term water quality monitoring during SM01.	OM03 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM03 are as follows: • The hydrocarbon release has ceased • Response activities have ceased • Concentrations of hydrocarbons in the water are below available ANZECC/ ARMCANZ (2018) trigger values for 99% species protection.
Operational Monitoring Operational Plan 4 (OM04) Pre-emptive assessment of sensitive receptors at risk	OM04 aims to undertake a rapid assessment of the presence, extent and current status of shoreline sensitive receptors prior to contact from the hydrocarbon spill, by providing categorical or semi-quantitative information on the characteristics of resources at risk. The primary objective of OM04 is to confirm understanding of the status and characteristics of environmental resources predicted by OM01 and OM02 to be at risk, to further assist in making decisions on the selection of appropriate response actions and prioritisation of resources. Indirectly, qualitative/semi-quantitative pre-contact information collected by OM04 on the status of environmental resources may also aid in the verification of environmental baseline data and provide context for the assessment of environmental impacts, as determined through subsequent SMPs. OM04 would be undertaken in liaison with WA DoT as the control agency once the oil is in State Waters (if a Level 2/3 incident).	Triggers for commencing OM04 include: • Contact of a sensitive habitat or shoreline is predicted by OM01, OM02 and/or OM03 • The pre-emptive assessment methods can be implemented before contact from hydrocarbons (once a receptor has been contacted by hydrocarbons it will be assessed under OM05)	The criteria for the termination of OM04 at any given location are: • Locations predicted to be contacted by hydrocarbons have been contacted • The location has not been contacted by hydrocarbons and is no longer predicted to be contacted by hydrocarbons (resources should be reallocated as appropriate)

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational monitoring operational plan 5 (OM05) Monitoring of contaminated resources	OM05 aims to implement surveys to assess the condition of fauna and habitats contacted by hydrocarbons at sensitive habitat and shoreline locations. The primary objectives of OM05 are: • Record evidence of oiled fauna (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 fauna 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 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 led in-field by a party chief).

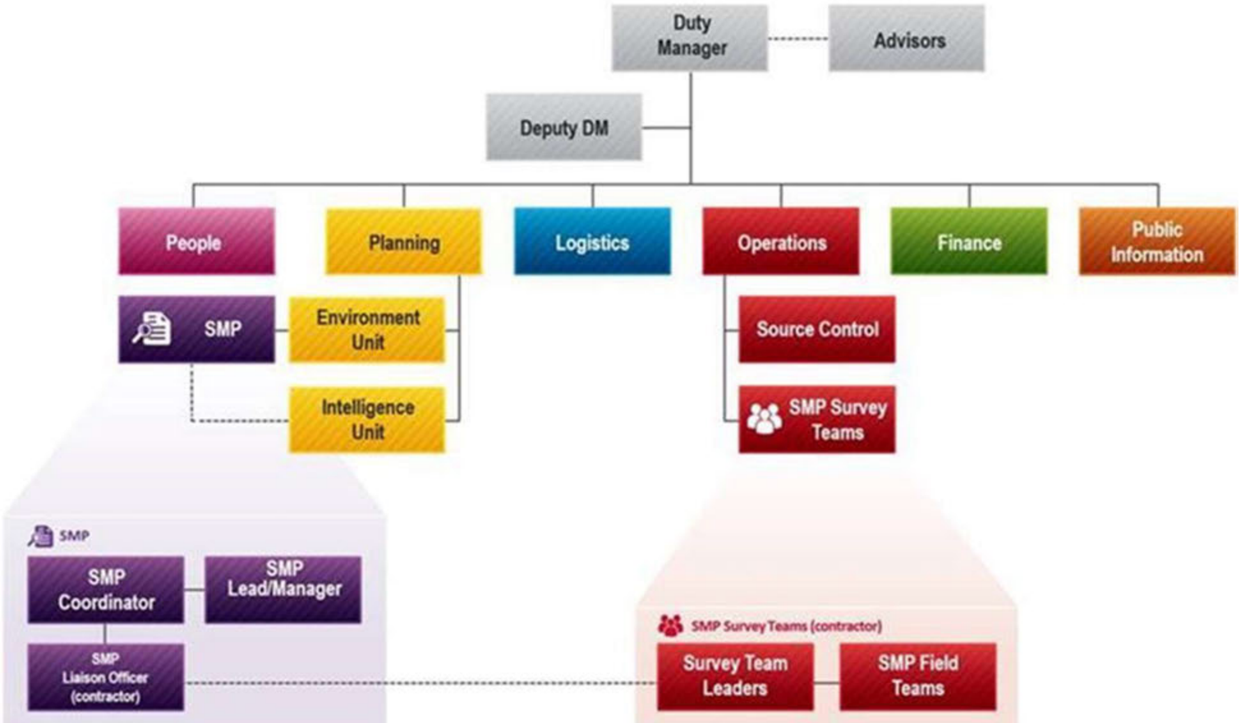

Figure C-1: Woodside Oil Spill Scientific Monitoring Program Delivery Team and Linkage to Incident Control Centre organisational structure.

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[18]) concentrations of 1 g/m2 for floating, 10 ppb for entrained and dissolved; and • Details of the extent, severity and persistence of hydrocarbons from concentrations recorded in water have been documented at sensitive receptor sites monitored under other SMPs.
Scientific monitoring program 2 (SM02) **Assessment of the Presence, Quantity and Character of Hydrocarbons in Marine Sediments**	SM02 will detect and monitor the presence, extent, persistence and properties of hydrocarbons in marine sediments following the spill and the response. The specific objectives of SM02 are as follows: • Determine the extent, severity and persistence of hydrocarbons in marine sediments across selected sites where hydrocarbons were observed or recorded during operational monitoring; and • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs.	SM02 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • Response activities have ceased; and • Operational monitoring results made during the response phase indicate that shoreline, intertidal or sub-tidal sediments have been exposed to surface, entrained or dissolved hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation).	SM02 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Concentrations of hydrocarbons in sediment samples are below ANZECC/ ARMCANZ (2013[19]) sediment quality guideline values (SQGVs) for biological disturbance; and • Details of the extent, severity and persistence of hydrocarbons from concentrations recorded in sediments have been documented.
Scientific monitoring program 3 (SM03) **Assessment of Impacts and Recovery of Subtidal and Intertidal Benthos**	The objectives of SM03 are: • Characterize the status of intertidal and subtidal benthic habitats and quantify any impacts to functional groups, abundance and density that may be a result of the spill; and • Determine the impact of the hydrocarbon spill and subsequent recovery (including impacts associated with the implementation of response options). Categories of intertidal and subtidal habitats that may be monitored include: • Coral reefs • Seagrass • Macro-algae • Filter-feeders SM03 will be supported by sediment contamination records (SM02) and characteristics of the spill derived from OMPs.	SM03 will be activated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • As part of a pre-emptive assessment of PBAs of receptor locations identified by time to hydrocarbon contact >10 days, to target receptors and sites where it is possible to acquire pre-hydrocarbon contact baseline; and • Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for subtidal and intertidal benthic habitat.	SM03 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Overall impacts to benthic habitats from hydrocarbon exposure have been quantified. • Recovery of impacted benthic habitats has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 4 (SM04) **Assessment of Impacts and Recovery of Mangroves / Saltmarsh**	The objectives of SM04 are: • Characterize the status of mangroves (and associated salt marsh habitat) at shorelines exposed/contacted by spilled hydrocarbons; • Quantify any impacts to species (abundance and density) and mangrove/saltmarsh community structure; and	SM04 will be activated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows:	SM04 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Impacts to mangrove and saltmarsh habitat from hydrocarbon exposure have been quantified.

[18] NOPSEMA (2019) Bulletin #1 – Oil spill modelling – April 2019, https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf
[19] Simpson SL, Batley GB and Chariton AA (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO and Water Science Report 08/07. Land and Water, pp. 132.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options). SM03 will be supported by sediment sampling undertaken in SM02 and characteristics of the spill derived from OMPs.	• As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; and • Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for mangrove/saltmarsh habitat.	• Recovery of impacted mangrove/saltmarsh habitat has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 5 (SM05) **Assessment of Impacts and Recovery of Seabird and Shorebird Populations**	The Objectives of SM05 are to: • Collate and quantify impacts to avian wildlife from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population level; and • Undertake monitoring to quantify and assess impacts of hydrocarbon exposure to seabirds and shorebird populations at targeted breeding colonies / staging sites / important coastal wetlands where hydrocarbon contact was recorded.	SM05 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Operational monitoring predicts shoreline contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at important bird colonies / staging sites / important coastal wetland locations; or • Records of dead, oiled or injured bird species made during the hydrocarbon spill or response.	SM05 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to seabird and shorebird populations from hydrocarbon exposure have been quantified. • Recovery of impacted seabird and shorebird populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 6 (SM06) **Assessment of Impacts and Recovery of Nesting Marine Turtle Populations**	The objectives of SM06 are to: • To quantify impacts of hydrocarbon exposure or contact on marine turtle nesting populations (including impacts associated with the implementation of response options); • Collate and quantify impacts to adult and hatchling marine turtles from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population levels (including impacts associated with the implementation of response options); .and • Undertake monitoring to quantify and assess impacts of hydrocarbon exposure to nesting marine turtle populations at known rookeries (including impacts associated with the implementation of response options).	SM06 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring has: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Predicted shoreline contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at known marine turtle rookery locations; or • Records of dead, oiled or injured marine turtle species made during the hydrocarbon spill or response.	SM06 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to nesting marine turtle populations from hydrocarbon exposure have been quantified. • Recovery of impacted nesting marine turtle populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 7 (SM07) **Assessment of Impacts to Pinniped Colonies including Haul-out Site Populations**	The objectives of SM07 are to: • Quantify impacts on pinniped colonies and haul-out sites as a result of hydrocarbon exposure/contact. • Collate and quantify impacts to pinniped populations from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population levels.	SM07 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring has: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Identified shoreline contact of hydrocarbons ((at or above 0.5 g/m^2 surface, ≥5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at known pinniped colony or haul-out site(s) (i.e. most northern site is the Houtman Abrolhos Islands); or • Records of dead, oiled or injured pinniped species made during the hydrocarbon spill or response.	SM07 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to pinniped populations from hydrocarbon exposure have been quantified. • Recovery of pinniped populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 8 (SM08) **Desk-Based Assessment of Impacts to Other Non-Avian Marine Megafauna**	The objective of SM08 is to provide a desk-based assessment which collates the results of OM02 and OM05 where observations relate to the mortality, stranding or oiling of mobile marine megafauna species not addressed in SM06 or SM07, including: • Cetaceans; • Dugongs;	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.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Whale sharks and other shark and ray populations; • Sea snakes; and • Crocodiles. The desk-based assessment will include population analysis to infer potential impacts to marine megafauna species populations.		• Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 9 (SM09) **Assessment of Impacts and Recovery of Marine Fish associated with SM03 habitats**	The objectives of SM09 are: • Characterise the status of resident fish populations associated with habitats monitored in SM03 exposed/contacted by spilled hydrocarbons; • Quantify any impacts to species (abundance, richness and density) and resident fish population structure (representative functional trophic groups); and • Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options).	SM09 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented with SMO3.	SM09 will be undertaken and terminated concurrent with monitoring undertaken for SM03, as per the SMP termination criteria process • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 10 (SM10) **SM10 - Assessment of physiological impacts important fish and shellfish species (fish health and seafood quality/safety) and recovery**	SM10 aims to assess any physiological impacts to important commercial fish and shellfish species (assessment of fish health) and if applicable, seafood quality/safety. Monitoring will be designed to sample key commercial fish and shellfish species and analyse tissues to identify fish health indicators and biomarkers, for example: • Liver Detoxification Enzymes (ethoxyresorufin-O-deethylase (EROD) activity) • PAH Biliary Metabolites • Oxidative DNA Damage • Serum SDH • Other physiological parameters, such as condition factor (CF), liver somatic index (LSI), gonado-somatic index (GSI) and gonad histology, total weight, length, condition, parasites, egg development, testes development, abnormalities. Seafood tainting may be included (where appropriate) using applicable sensory tests to objectively assess targeted finfish and shellfish species for hydrocarbon contamination. Results will be used to make inferences on the health of commercial fisheries and the potential magnitude of impacts to fishing industries.	SM10 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring (OM01, OM02 and OM05) indicates the following: • The hydrocarbon spill will or has intersected with active commercial fisheries or aquaculture activities. • Commercially targeted finfish and/or shellfish mortality has been observed/recorded. • Commercial fishing or aquaculture areas have been exposed to hydrocarbons (≥0.5 g/m^2 surface and ≥5 ppb for entrained/dissolved hydrocarbons); and • Taste, odour or appearance of seafood presenting a potential human health risk is observed.	SM10 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Physiological impacts to important commercial fish and shellfish species from hydrocarbon exposure have been quantified. • Recovery of important commercial fish and shellfish species from hydrocarbon exposure has been evaluated. • Impacts to seafood quality/safety (if applicable) have been assessed and information provided to the relevant stakeholders and regulators for the management of any impacted fisheries. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.

Activation Triggers and Termination Criteria

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 FSP for the petroleum activity programme. The presence of any level of hydrocarbons in the marine environment triggers the activation of the oil spill scientific monitoring program (SMP). This is to ensure the full range of eventualities relating to the environmental, socio-economic and health consequences of the spill are considered in the planning and execution of the SMP. The activation process also takes into consideration the management objectives, species recovery plans, conservation advices and conservations plans for any World Heritage Area (WHA), AMPs, State Marine Parks, other protected area designations (e.g., State nature reserves) and Matters of National Environmental Significance (including listed species under part 3 of the EPBC Act) potentially exposed to hydrocarbons. With the first 24-48 hours of a spill event, such information will be sourced and evaluated as part of the SMP planning process guided by Appendix D (identified receptors vulnerable to hydrocarbon contact), the information presented in the Existing Environment section of the EP as well as other information sources such as the Woodside Baseline Environmental Studies Database.

The starting point for decision-making on which SMPs are activated, and the spatial extent of monitoring activities, will be based on the predictive modelling results (OM01) in the first 24-48 hours until more information is made available from other operational monitoring activities such as aerial surveillance and shoreline surveys. Pre-emptive Baseline Areas (WHA, AMPs and State Marine Parks encompassing key ecological and socio-economic values) are a 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).

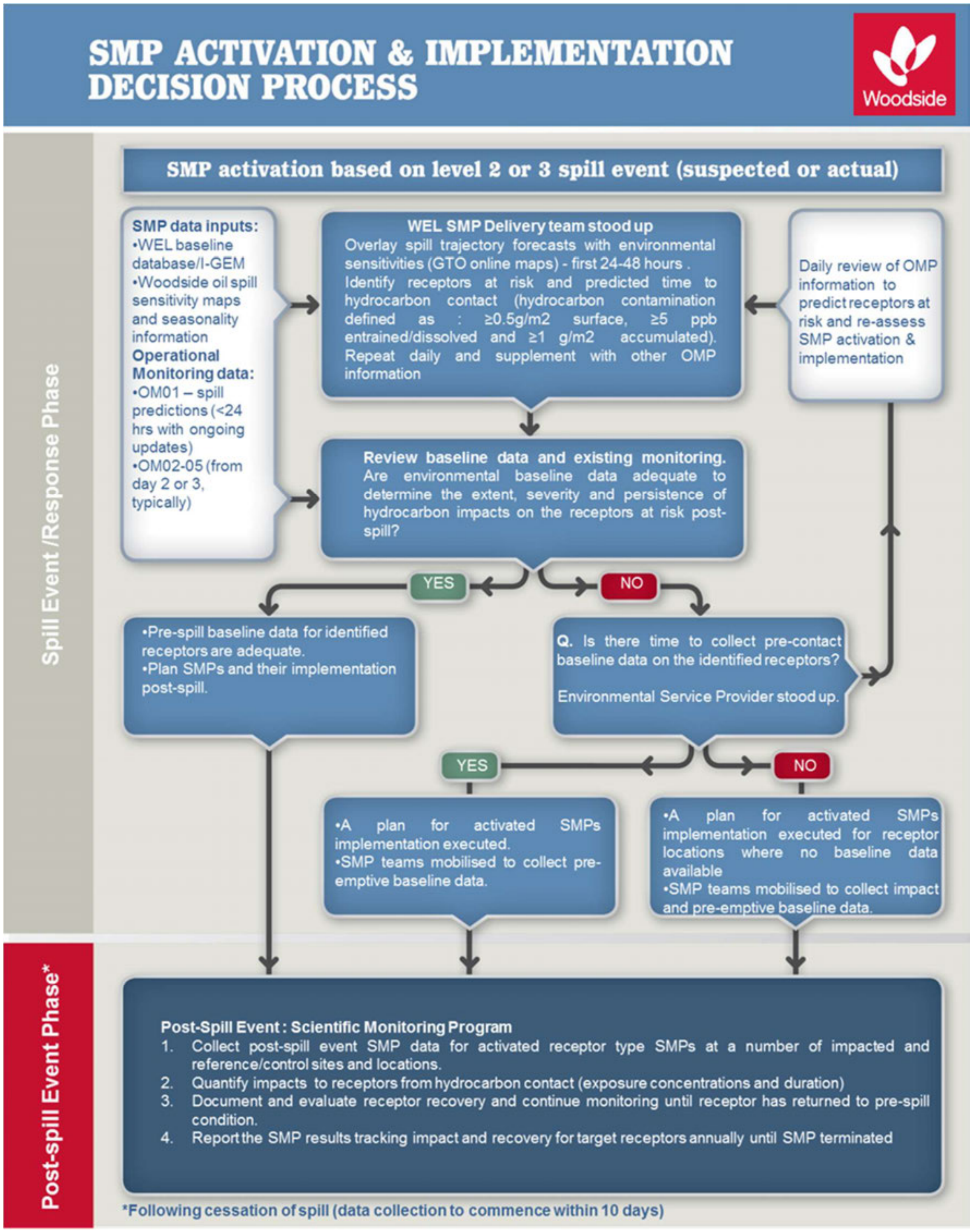

Figure C-2: Activation and Implementation Decision-tree for Oil Spill Environmental Monitoring

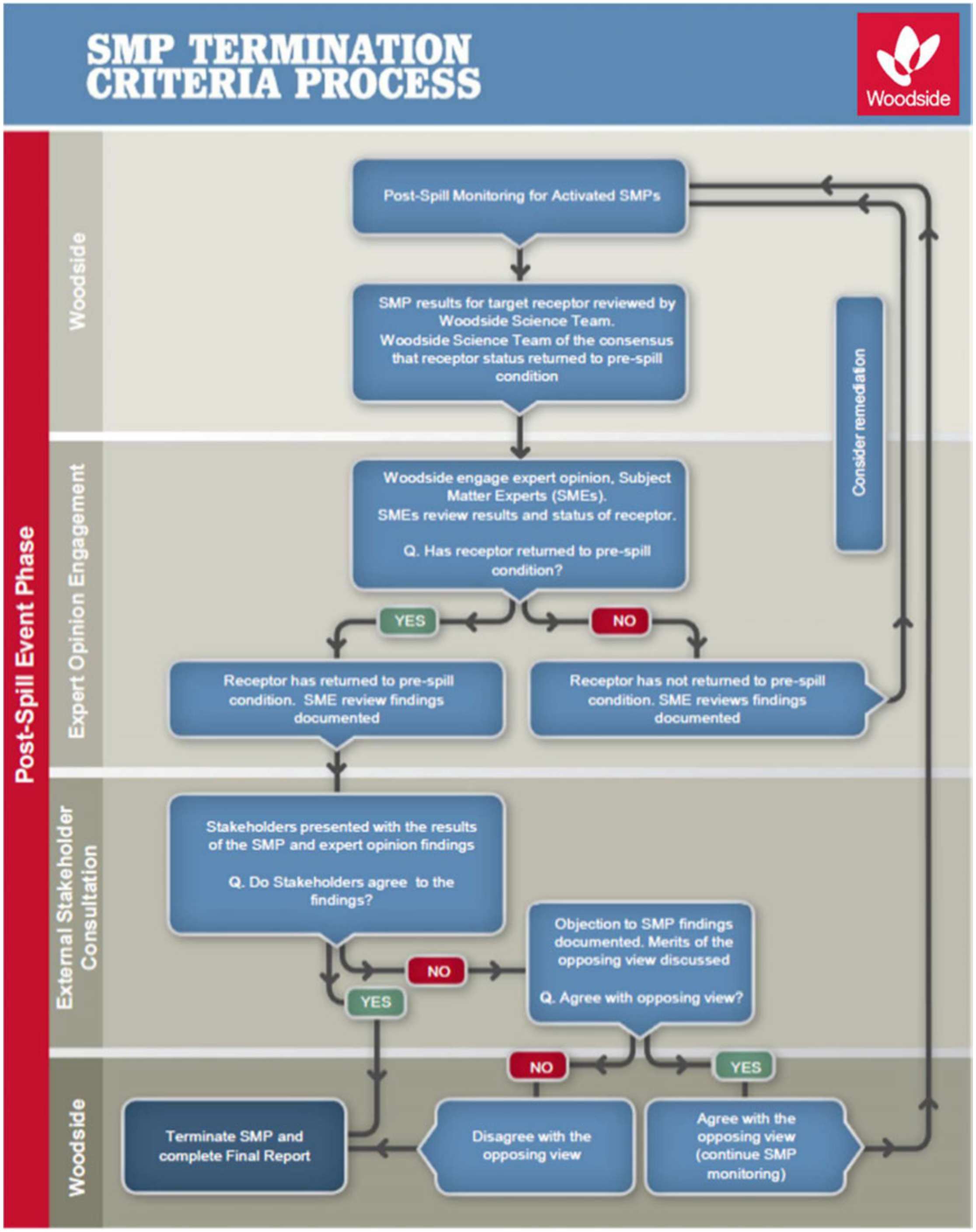

Figure C-3: Termination Criteria Decision-tree for Oil Spill Environmental Monitoring

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 Pre-emptive Baseline Areas (PBAs) where hydrocarbon contact is predicted to occur <10 days.

In addition to Woodside's Environmental Knowledge Management System, it is acknowledged that many relevant baseline datasets are held by other organisations (e.g. other oil and gas operators, government agencies, state and federal research institutions and non-governmental organisations). In order to understand the present status of environmental baseline studies a spatial environmental metadata database for Western Australia (Industry-Government Environmental Metadata, I-GEM) was established. IGEM is a collaboration comprising oil and gas operators (including Woodside), government and research agencies and other organisations. 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 Pre-emptive Baseline Areas (PBAs), i.e., receptors at risk where hydrocarbon contact is predicted to be >10 days, and baseline data can be collected before hydrocarbon contact.

Reporting

For the scientific monitoring program relevant regulators will be provided with:

- Annual reports summarising the SMPs deployed and active, data collection activities and available findings; and
- Final reports for each SMP summarising the quantitative assessment of environmental impacts and recovery of the receptor once returned to pre-spill condition and termination of the monitoring program.

The reporting requirements of the scientific monitoring program will be specific to the individual SMPs deployed and terms of responsibilities, report templates, schedule, QA/QC and peer-review will be agreed with the contractors engaged to conduct the SMPs. Compliance and auditing mechanisms will be incorporated into the reporting terms

ANNEX D: SCIENTIFIC MONITORING PROGRAM AND BASELINE STUDIES FOR THE PETROLEUM ACTIVITIES PROGRAM

Table D-1: Oil Spill Environmental Monitoring – scientific monitoring program scope for the Petroleum Activities Program based on Spill EMBA for MEE-01 and 05 (Table 2-1)

Receptor Areas - Potential Impact and Reference Scientific Monitoring Sites (marked X)

Receptors to be Monitored	Applicable SMP	Kimberley AMP	Agro-Rowley Terrace AMP	Montebello AMP	Dampier AMP	Carnarvon Canyon AMP	Ningaloo AMP	Gascoyne AMP	Shark Bay Open Ocean (including AMP)	Abrolhos AMP	Jurien AMP	Two Rocks AMP	Perth Canyon AMP	Geographe AMP	South-west Corner AMP	Ashmore Reef and AMP	Seringapatam Reef	Scott Reef (North and South)	Mermaid Reef and AMP	Clerke Reef and State Marine Park	Imperieuse Reef and State Marine Park
Habitat																					
Water Quality	SM01	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
Coral Reef	SM03	X		X												X	X	X	X	X	X
Seagrass / Macro-Algae	SM03	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
Mangroves and Saltmarsh	SM04																				
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
Marine Turtles (significant nesting beaches)	SM06	X	X	X	X		X	X	X							X	X	X	X	X	X
Pinnipeds (significant colonies / haul-out sites)	SM07									X	X	X			X						
Cetaceans - Migratory Whales	SM08	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
Dugongs	SM08	X							X							X					
Sea Snakes	SM08	X		X	X			X	X	X						X	X	X	X	X	X
Whale Sharks	SM08			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
Fish Assemblages	SM09	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									
Fisheries - Traditional	SM10															X	X	X			
Tourism (incl. recreational fishing)	SM10	X		X			X	X	X		X			X	X	X	X	X	X	X	X

Receptors to be Monitored	Applicable SMP	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
Marine Sediment Quality	SM02	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	
Seagrass / Macro-Algae	SM03						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			
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
Marine Turtles (significant nesting beaches)	SM06						X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pinnipeds (significant colonies / haul-out sites)	SM07																				X
Cetaceans - Migratory Whales	SM08						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
Dugongs	SM08							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	
Whale Sharks	SM08							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
Fish Assemblages	SM09	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
Fisheries - Traditional	SM10						X													X	
Tourism (incl. recreational fishing)	SM10	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X

(dark red)	Receptor areas identified as Pre-emptive Baseline Areas (based on criteria of surface contact and/or entrained hydrocarbon contact ≤10 days (Offshore Australian Marine Parks contacted by hydrocarbons in this timeframe also noted)
(light red)	Receptor areas identified as Pre-Emptive Basline Areas in the response phase >10 days (based on criteria of surface contact and/or entrained hydrocarbon contact >10 days)
(white)	Receptor areas that may be identified as impact or reference sites in the event of major hydrocarbon release and would be identified as part of the SMP planning process

Table D-2: Baseline Studies for the SMPs applicable to identified Pre-emptive Baseline Areas for the Petroleum Activities Program

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	Montebello AMP
Benthic Habitat (Coral Reef)	SM03 Quantitative assessment using image capture using either diver held camera or towed video. Post analysis into broad groups based on taxonomy and morphology.	Studies:				
		1. Broad benthic habitat classifications and habitat maps for the Montebello islands by DBCA. 2. Coral monitoring at sites across Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3. Benthic community monitoring as part of DBCA Western Australian Marine Monitoring Program (2015-ongoing. 4. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Chevron LTM of corals for the Gorgon Gas Development. Marine Baseline Program (2008), Marine Monitoring Program (2010) Post Development Surveys (2011 – 2013). 2.Coral monitoring at sites around Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3.Benthic community (coral, seagrass and macroalgae) monitoring as part of DBCA's Western Australian Marine Monitoring Program (2015-ongoing). 4.Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitats surrounding the Lowendal Islands for the Gorgon Gas Development. Coral assemblages on the eastern side of Double Island, and coral bommies on the south-western edge of the Lowendal Shelf. 2. Coral monitoring at sites across Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	Coral Reefs & Filter Feeders 1. Montebello Marine Park, 2019, Identification and qualitative descriptions of benthic habitat. 2. Montebello Australian Marine Parks – 2019 – Baseline survey on benthic habitats. 3. Pluto Trunkline within Montebello Marine Park – Monitoring marine communities.
		Methods:				
		1. Habitat mapping. 2. Quantitative assessment details not available. 3. Drop camera. 4. Fixed long-term monitoring sites. Diver video transect. 5. Towed video, benthic trawl and sled.	1. Belt transect, size class frequency, video transects, photo quadrat, tagged colonies and terracotta tiles for coral recruitment. 2. Quantitative assessment 3. Fixed long-term monitoring sites. Diver video transects. 4. Towed camera, benthic trawl and sled.	Benthic habitat mapping, diver swum transects, tagged colonies. Quantitative assessment Towed video, benthic trawl and sled.	1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system.	1.ROV Transects. 2. Benthic habitat mapping, multibeam acoustic swathing. 3. ROV video.
		References and Data:				
		1. DBCA 2007. DATAHOLDER: DBCA. 2. RPS, 2012. DATAHOLDER: Santos. 3. DATAHOLDER: DBCA. 4. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. RPS, 2012. DATAHOLDER: Santos. 3. Bancroft 2009. DATAHOLDER: DoEE. 4. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron. 2. RPS, 2012. DATAHOLDER: Santos. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et al. 2019. DATAHOLDER: AIMS 4. Currey-Randall et al. 2019. DATAHOLDER: AIMS	1. Advisian 2019 2. Keesing 2019 3. McLean et al. 2019
		Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	**Montebello AMP**
Benthic Habitat (Seagrass and Macro-algae)	SM03 Quantitative assessment using image capture using either diver held camera or towed video. Post analysis into broad groups based on taxonomy and morphology.	1. Santos, macroalgae monitoring at sites across Lowendal and the Montebello islands in 2012. 2. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Chevron LTM of Seagrass and Macro algae habitats for the Gorgon Gas Development project. Marine baseline Program (2008, 2009), Marine Monitoring Program (2010), Post Dredge Survey one (2011) 2. Chevron study by RPS in 2004 on Barrow Island intertidal zone. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitats including seagrass and macroalgae for the (Lowendal Islands, Chevron Janz Feed Gas Pipeline Project.) Gorgon Gas Development Project. 2. Santos macroalgae monitoring at sites across Lowendal and the Montebello islands in 2012. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	N/A – see table D – 1
		Methods:				
		1. Quantitative assessment details not available. 2. Towed video, benthic trawl and sled.	1. Diver transects, photo quadrats, biomass. 2. Physical observational survey of intertidal habitats on Barrow Island. 3. Towed video, benthic trawl and sled.	1. Diver Transects, Photo Quadrats. 2. Quantitative assessment details not available. 3. Towed video, benthic trawl and sled.	1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system	N/A – see table D – 1
		References and Data:				
		1. RPS 2012. DATAHOLDER: Santos. 2. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron Australia. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron. 2. RPS 2012. DATAHOLDER: Santos. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et al. 2019. DATAHOLDER: AIMS 4. Currey-Randall et al. 2019. DATAHOLDER: AIMS	N/A – see table D – 1
	SM03	Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	Montebello AMP
Benthic Habitat (Deeper Water Filter Feeders)	Quantitative assessment using image capture using towed video. Post analysis into broad groups based on taxonomy and morphology.	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	N/A – see table D – 1
		Methods:				
		N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system	N/A – see table D – 1
		References and Data:				
		N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et al. 2019. DATAHOLDER: AIMS 4. Currey-Randall et al. 2019. DATAHOLDER: AIMS	N/A – see table D – 1
Mangroves and Saltmarsh	SM04	Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	**Montebello AMP**
	Aerial photography and satellite imagery will be used in conjunction with field surveys to map the range and distribution of mangrove communities.	1. Atmospheric correct and land cover classification, NW Cape. 2. Advanced Land Observing Satellite (ALOS) images taken in 2006, 2008, and 2010 by DBCA. Digital Aerial Photos were taken in 2009, and the area ground-truthed in 2006. 3. Ground truthing aerial photography to map the spatial extent of mangroves on the Montebello Islands. 4. Mangrove monitoring as part of DBCA Western Australian Marine Monitoring Program (ongoing).	Chevron LTM of Mangroves for the Gorgon Gas Development project. Marine Baseline Program (2009), Post Dredge Survey 1 (2011), Post Dredge Survey 2 (2013). Baseline state of the mangroves 2008.	1. Atmospheric correct and land cover classification, NW Cape. 2. Santos Mangrove baseline (2010). 3. Santos - Long-term mangrove monitoring (1999-2011).	N/A – See Table D-1	N/A – see table D – 1
		Methods:				
		1. Modular Inversion Program. May 2017 2. ALOS and Digital aerial photos, ground truthing, for Mangrove extent and mangrove relative canopy density. 3. Species Composition, LUX, canopy density. 4. Methods unknown.	1.Health scoring system, percentage cover, mean canopy density, qualitative health assessment. 2. Annual Mangrove composition, canopy density, pneumatophore density, leaf pathology, qualitative health.	1. Modular Inversion Program. May 2017 2.Aerial imagery (resolution of 0.2 m2 captured in 2010). 3. Qualitative data includes the presence of new growth, reproductive state, extent of defoliation and pneumatophore condition. Quantitative data, collected at the tree level, includes seedling density, stem diameter, number of defoliated branches and a number of canopy condition parameters.	N/A – See Table D-1	N/A – see table D – 1
		References and Data:				
		1. EOMAP, 2017 DATAHOLDER: Woodside. 2.DBCA unpublished data. DATAHOLDER: DBCA. 2. Voga unpublish data DATAHOLDER: Voga Contact: voga.envrironment@vermilionenergy.com 3. DBCA. DATAHOLDER DBCA.	Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. Chevron 2014. DATAHOLDER: Chevron.	1. EOMAP, 2017 DATAHOLDER: Woodside. 2.Santos 2014. DATAHOLDER: Santos. 3. Santos 2011. DATAHOLDER: Santos.	N/A – See Table D-1	N/A – see table D – 1
Seabirds	SM05	Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	**Montebello AMP**
	Visual counts of breeding seabirds, nest counts, intertidal bird counts at high tide.	No recent studies. A DBCA/WAM study of terrestrial fauna of the islands was published in 2000 (Burbidge et al 2000). The most recent bird survey referenced in this review was 1998 by DBCA (DPaW, CALM).	1. Barrow Island migratory behaviour, nesting and foraging behaviour. 2. Migratory waders at Barrow Island. 3. LTM on Barrow island (island wide) Study September 2003 – 2006. 4. Chevron - Gorgon Gas Development. Terrestrial and subterranean environment monitoring program (2008-2015). Monitoring of Wedge-tailed Shearwaters, Bridled Terns, Silver Gulls.	1. Ongoing study of Bridled Terns from 2009. 2. Quadrant Energy seabird nesting on Lowendal Island, study 2013. 3. Lowendal Islands, common breeding bird species, structure, feeding and disturbances to the population. 4. Quadrant Energy/Santos – Integrated Shearwater Monitoring Program (1994-2016).	N/A – See Table D-1	Present, in open water, no breeding habitat.
		Methods:				
		Bird observations and counts.	Species, total numbers, Distribution, Roosting locations and foraging numbers. Migratory behaviour. High tide roost counts, abundance counts. Nest burrow density (number of burrows per m2); presence/absence of eggs or chicks in burrows; collapsed burrows and predation and mortality records. Barrow Island: Variation in abundance and spatial/temporal distribution on beaches. Middle Island: Abundance; nest density; Presence and absence of eggs/chicks in nest.	1. Nest Density, presence and absence of chicks, predation and mortality counts. 2. Nest burrow density (number of burrows per m2); presence/absence of eggs or chicks in burrows. 3. Burrowscopes, Ultrasonic monitors to monitor burrows. 4. The distribution and abundance of other nesting seabirds within the Lowendal Island group, including up to 45 islands and islets, also occurred from 2004 onwards.	N/A – See Table D-1	N/A
		References and Data:				
		DBCA/WAM – Burbidge et al 2000.	Bamford M.J. & A.R 2004. DATAHOLDER: Chevron. Bamford M.J & A.R 2011. DATAHOLDER: Chevron. Chevron, 2013. DATAHOLDER: Chevron. Chevron 2013. DATAHOLDER: Chevron.	1. Bamford M.J. & A.R 2004. DATAHOLDER: Chevron. 2. Surman 2012. DATAHOLDER: Santos. 3. Bamford M.J & A.R 2011. DATAHOLDER: Chevron. 4. DATAHOLDER: Santos.	N/A – See Table D-1	N/A
Turtles	SM06	Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	Montebello AMP
	Beach surveys (recording species, nests, and false crawls).	1. LTM Study of Green, Flatback, Hawksbill turtles on beaches within the Barrow, Lowendal and Montebello Island Complex for Chevron. 2. Marine turtle monitoring as part of DBCA long-term turtle monitoring program (ongoing).	Chevron - Gorgon Gas Development. Long-term Turtle Monitoring Program - Flatback tagging program and marine turtle track census program (2005 – ongoing).	1. LTM Study of Green, Flatback, Hawksbill turtles on beaches within the Barrow, Lowendal and Montebello Island Complex. 2. Santos 2013 turtle nesting survey on the Lowendal islands. 3. Varanus Island Turtle monitoring program (2005 – present).	N/A – See Table D-1	Present, in open water, no nesting habitats.
		Methods:				
		Nesting demographics (composition, spatial variability, seasonal distribution, post-nesting dispersion).	Island wide (though primary nesting occurs on east coast). Mundabullangana on mainland is the reference location for the Flatback tagging program.	1. Nesting demographics (composition, spatial variability, seasonal distribution, post-nesting dispersion). 2. Tagging and nest counts. 3. Tagging and nest counts. Varanus, Beacon, Bridled, Abutilon and Parakeelya islands.	N/A – See Table D-1	N/A
		References and Data:				
		1. AMOSC/DPaW 2014. DATAHOLDER: Chevron. 2.DBCA.	Pendoley Environmental (2005-ongoing). DATAHOLDER: Chevron.	1. Pendoley 2005. AMOSC/DBCA (DPaW) 2014. DATAHOLDER: Chevron/ Santos. 2. Santos, 2014. DATAHOLDER: Santos. 3. Santos (2005 – present)	N/A – See Table D-1	N/A
Fish	SM09 Baited Remote Underwater Video Stations (BRUVS), Visual Underwater Counts (VUC), Diver Operated Video (DOV).	Studies:				
		1. DBCA diver surveys 2009-2012. 2. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~8-20m) in 2014 and deeper (20-60m) in 2015 inside and outside sanctuary zones at the Montebello Islands and in the area from Cape Preston to the Montebello Islands in 2015. 3. Finfish monitoring as part of DBCA Western Australian Marine Monitoring Program (2015-ongoing).	1. Chevron LTM of demersal fish for the Gorgon Gas Development project. Marine Baseline Program (2008, 2009), Post Dredge Survey 1 (2011), Post Dredge Survey 2 (2012). 2. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~10m) from Exmouth to Barrow Islands in 2015. 3. Finfish monitoring as part of DBCAs Western Australian Marine Monitoring Program (2015-ongoing).	1. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~10m) Montebello Sanctuaries 2015. 2. WA Museum fish surveys of Dampier Archipelago 1998-2000 (Hutchins 2004).	1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	1. CSIRO – Fish Diversity. 2. Fish species richness and abundance.
		Methods:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoals	**Montebello AMP**
		1. Diver Operated Video - species richness, community composition, and biomass were recorded from 2009-2012. 2. Stereo BRUVS. 3. Diver UVS.	1. Intertidal and subtidal surveys using BRUVS and Netting. 2. Stereo BRUVS. 3. Diver UVS.	1. Stereo BRUVS 2. Diver surveys _ Underwater Visual Census (UVC).	1. BRUVs. 2. BRUVs. 3. BRUVs. 4. BRUVs.	1. Semi V Wing trawl net or an epibenthic sled. 2. ROV Video.
		References and Data:				
		1. DBCA data. DATAHOLDER: DBCA 2. CSIRO Data DATAHOLDER: CSIRO Data centre (data-requests-hf@csiro.au) 3. DBCA.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011. Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. CSIRO Data DATAHOLDER: CSIRO Data centre (data-requests-hf@csiro.au) 3. DBCA.	1. UWA. The UWA Oceans Institute & School of Biological Sciences. 2. DATAHOLDER: Woodside and WAM.	1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et al. 2019. DATAHOLDER: AIMS 4. Currey-Randall et al. 2019. DATAHOLDER: AIMS	1. Keesing 2019. 2. McLean et al. 2019.

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Chevron Australia (2014). Gorgon Gas Development and Jansz Feed Gas Pipeline: Post-Development Coastal and Marine State and Environment Impact Survey Report, Year 2:2012-2013. Document number G1-NT-REPX0005152. Pp. 362 https://www.chevronaustralia.com/docs/default-source/default-document-library/gorgon-emp-post-development-coastal-and-marine-state-and-environmental-impact-survey.pdf?sfvrsn=4

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ANNEX E: TACTICAL RESPONSE PLANS

TACTICAL RESPONSE PLANS
Exmouth
Mangrove Bay
Turquoise Bay
Yardie Creek
Muiron Islands
Jurabi to Lighthouse Beaches Exmouth
Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek
Exmouth Gulf
Shark Bay Area 1: Carnarvon to Wooramel
Shark Bay Area 2: Wooramel to Petite Point
Shark Bay Area 3: Petite Point to Dubaut Point
Shark Bay Area 4: Dubaut Point to Herald Bight
Shark Bay Area 5: Herald Bight to Eagle Bluff
Shark Bay Area 6: Eagle Bluff to Useless Loop
Shark Bay Area 7: Useless Loop to Cape Bellefin
Shark Bay Area 8: Cape Bellefin to Steep Point
Shark Bay Area 9: Western Shores of Edel Land
Shark Bay Area 10: Dirk Hartog Island
Shark Bay Area 11: Bernier and Dorre Islands
Abrohlos Islands: Pelseart Group
Abrohlos Islands: Wallabi Group
Abrohlos Islands: Easter Group
Dampier
Rankin Bank & Glomar Shoals
Barrow and Lowendal Islands
Pilbara Islands - Southern Island Group
Montebello Island - Stephenson Channel Nth TRP
Montebello Island Champagne Bay and Chippendale channel TRP
Montebello Island - Claret Bay TRP
Montebello Island - Hermite/Delta Island Channel TRP
Montebello Island - Hock Bay TRP
Montebello Island - North and Kelvin Channel TRP
Montebello Island - Sherry Lagoon Entrance TRP
Withnell Bay
Holden Bay
King Bay
No Name Bay / No Name Beach
Enderby Is -Dampier

Rosemary Island - Dampier
Legendre Is - Dampier
Karratha Gas Plant
KGP to Whitnell Creek
KGP to Northern Shore
KGP Fire Pond & Estuary
KGP to No Name Creek
Broome
Sahul Shelf Submerged Banks and Shoals
Clerke Reef (Rowley Shoals)
Imperieuse Island (Rowley Shoals)
Mermaid Reef (Rowley Shoals)
Scott Reef
Oiled Wildlife Response
Exmouth
Dampier region
Shark Bay

APPENDIX F STAKEHOLDER CONSULTATION PHASE I

Woodside Consultation Material

Consultation with all relevant stakeholders – 8 July 2019

Woodside sent the email below and consultation Information Sheet to all relevant stakeholders.

Dear Stakeholder

Woodside is planning to submit a revised Operations Environment Plan for the Okha floating production storage and offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

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:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line • A 500 m radius Operational Area around four suspended exploration wells

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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under new public transparency arrangements being implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

Woodside consultation Information Sheet

Woodside

STAKEHOLDER CONSULTATION
INFORMATION SHEET

July 2019

OKHA OPERATIONS

CARNARVON BASIN, NORTH-WEST AUSTRALIA

Woodside is submitting a revised Environment Plan for the Okha Floating Production, Storage and Offloading (FPSO) facility in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations).

The regulations require that Environment Plans for operating facilities be revised at least every five years.

The Okha facility is operated by Woodside on behalf of the North West Shelf Project participants. The participants are Woodside Energy Ltd., BHP Billiton Petroleum (North West Shelf) Pty Ltd, BP Developments Australia Pty Ltd, Chevron Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd and Shell Australia Pty Ltd.

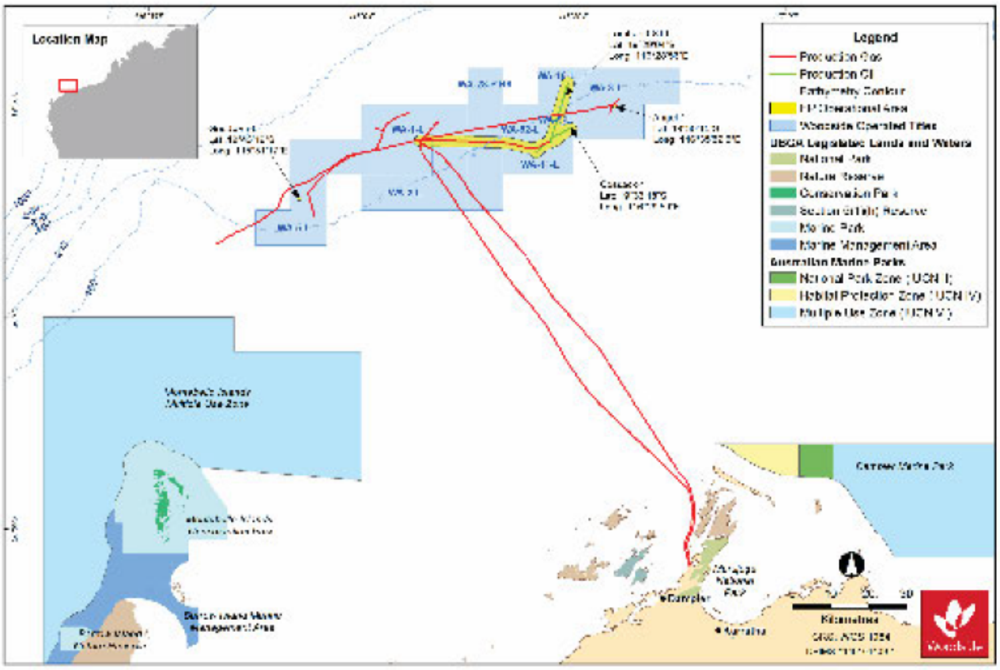


Table 1. Activity summary

Okha FPSO facility	
Facility type	+ Oil and gas production facility + Subsea wells and infrastructure, a riser turret production and mooring system, the Okha FPSO and a gas export line
Distance from facility to nearest port	+ 115 km north west of Dampier, Western Australia
Water depth at facility	+ Approximately 80 m
Facility coordinates	+ Latitude: 19° 35' 13"S + Longitude: 116° 26' 29"E
Number of wells	There are 13 subsea production wells tied back to the Okha FPSO, of which 10 are capable of producing hydrocarbons + One well tied back from the Cossack field + Eight wells tied back from the Wanaea field + Two wells tied back from the Lambert field + Two wells tied back from the Hermes field Four suspended exploration wells will also be included in the Environment Plan, these being Goodwyn-6, Angel-1, Cossack-1 and Lambert 5ST1.
Commissioned	+ The Okha FPSO commenced production in September 2011. Prior to this, the oil and gas from the fields were produced through the Cossack Pioneer FPSO, which commenced production in 1995
Distance to nearest marine park	+ Approximately 120 km north west of the Montebello Islands Marine Park (WA) + Approximately 72 km north west of Montebello Marine Park - Multiple Use Zone (Cwlth)

Operations

The Okha FPSO extracts, processes, stores and offloads oil and export gas from the Cossack, Wanaea, Lambert and Hermes fields.

Oil is dispatched from the FPSO to trading tankers whilst export gas is transported via a 32 km gas export line to North Rankin Complex (NRC). Gas is subsequently transported from the NRC to the Karratha Gas Plant via two 130 km trunklines.

The offshore production system consists of subsea wells and infrastructure (e.g. wellheads, Xmas trees, manifolds, umbilicals, flowlines and risers), a riser turret production and mooring system, the FPSO and the gas export line.

Activity Location

The Okha FPSO is located about 115 km north west of Dampier, Western Australia with petroleum activities undertaken in production licence areas WA-11-L, WA-9-L, WA-16-L.

The Operational Area for this Environment Plan includes:

+ The Okha FPSO and the area around the facility extending out to 1500 m to allow for offtake activities (including the 500 m petroleum safety zone)
+ The Okha FPSO subsea infrastructure, including wells and flowlines, and an area 1500 m from the infrastructure
+ The gas export line to a pipeline end manifold adjacent to NRC which is located in WA-4-PL and an area within 1500 m around the infrastructure
+ The four suspended exploration wells and an area within 500 m around the infrastructure

Activity Details

The Okha FPSO normally operates 24 hours per day, 365 days per year. Activities undertaken include:

Production and maintenance

Production and maintenance involve receiving hydrocarbons from the reservoirs, processing, storing oil for offloading to export tankers, exporting gas to the NRC and supporting operations.

Routine inspection, maintenance and repair of the Okha FPSO may be undertaken. Inspection and maintenance are carried out to ensure the integrity of the facility and identify any risks if they pose a risk.

Production and major projects

Major projects involves refurbishment, modification or major maintenance on the facility. An assessment will be undertaken whether an Environment Plan revision is required if a project scope has the potential to result in significant change to the facility.

FPSO marine (disconnected) mode

The FPSO can operate as a self-propelled vessel to avoid adverse weather conditions or for maintenance or modification works at a shipyard. The FPSO must comply with all applicable maritime regulations once disconnected from the riser turret mooring.

Activity Vessels

Support vessels are used to transfer materials and equipment to and from the facility. While in the field, vessels also backload materials and segregates waste for transportation back to the King Bay Supply Facility in Dampier, as well as carrying out standby duties during helicopter operations and working over the side activities. The current schedule is for a support vessel to visit the facility about every two weeks.

Support vessels are also required for inspection, monitoring, maintenance and repair activities, and may vary depending on operational requirements, vessel schedules and capability. Activities will be conducted intermittently and over short durations in the immediate vicinity of subsea infrastructure and no additional exclusion zones will be in place during these activities.

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 petroleum activities.

A number of mitigation and management measures will be implemented and are summarised in the Table 2. Further details will be provided in the Environment Plan.

Table 2. Summary of key risks and/or impacts and management measures

Potential Risk and/or Impact	Mitigation and/or Management Measure
Planned	
Chemical use	+ Chemical use will be managed in accordance with Woodside and contractor chemical selection and approval procedures.
Emissions from fuel combustion	+ Procedures to keep emissions from combustion of fuel (e.g. power generation) in line with design specifications will be followed. + Fuel gas is the preferred source of fuel. Emissions will be reported in accordance with regulatory requirements.
Flaring	+ Gas flaring will be managed to a level required for safe and reliable production. + Unplanned flaring will be minimised where possible and managed in accordance with annual performance targets.
Interests of relevant stakeholders including: + **Defence activities** + **Petroleum activities** + **Commercial 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 revision of the Environment 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	+ Lifting and lifted equipment will be in a safe and serviceable condition to prevent dropped objects. + Lifting operations will be safely performed to minimise potential for dropped objects overboard.
Vessel interaction	+ Use of navigational aids and practices as required by Maritime Regulations to minimise impact on other marine users. + A 500 m radius petroleum safety zone around the Okha FPSO. + A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines, and the gas export line. + Commercial fishers and other marine users are permitted 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. + Wastes will be managed and disposed of in a safe and environmentally responsible manner that aims to 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 **Wednesday, 7 August 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, *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

Consultation with specific stakeholders

Woodside sent the following emails, consultation Information Sheet, activity maps and other information relevant to specific stakeholder interests.

Email to WAFIC and DPIRD – 8 July 2019

Dear [redacted]

Woodside is planning to submit a revised Operations Environment Plan for the Okha floating production storage and offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to as low as reasonably practical (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.

An information sheet (also available on our website) and maps of State Fisheries relevant to the proposed activities are also attached.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
State fisheries consulted for this activity*:	• Pilbara Trawl Fishery • Pilbara Trap Fishery • Pilbara Line Fishery • Mackerel Fishery
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line • A 500 m radius Operational Area around four suspended exploration wells

* 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

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	• The presence of the Okha FPSO and subsea infrastructure may result in exclusion of other users, or interactions between vessels and the facility.	• Woodside will implement a 500 m petroleum safety zone around the Okha FPSO to reduce the likelihood of interactions with the NRC. • Notification and updates to 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 may occur due to the physical presence of the Okha FPSO and subsea infrastructure and subsea maintenance, inspection and repair (IMR) activities.	• Woodside will seek to minimise seabed disturbance during Okha FPSO operations through: - The use of vessels with dynamic positioning for IMR - Monitoring and maintenance of subsea infrastructure to manage scour and flowline movement within integrity envelope. -
Underwater noise	• Noise will be generated by the Okha FPSO, vessels, helicopters and IMR activities.	• Due to the low acoustic source levels associated with Okha FPSO and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges	• Operational discharges including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • Routine discharges of approved chemicals and residual hydrocarbons as a result of IMR activities. • Both these discharges may result in a localised short-term reduction in water quality however they will	• Discharges are compliant with industry best practice standards. • Implementation of chemical assessment and approval process. • Flushing of subsea infrastructure where practical to reduce volume of residual hydrocarbon discharged. • The produced water discharge is monitored and managed to achieve 99% species protection.

	be rapidly diluted and dispersed in the water column.	
Unplanned Risks		
Hydrocarbon release	• Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting in a tank rupture.	• Compliance with industry best practice standards and procedures. • Bunkering procedures • Well design and barriers to prevent a loss of well integrity. • Blow out Preventer (BOP) • In the unlikely event of an oil spill or unplanned discharge into the environment, relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. • Oil spill response strategies will be 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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under new public transparency arrangements being implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

Email to DPIRD – 8 July 2019

Hi [redacted] – I received an auto response from [redacted] providing your contact details as [redacted] is on secondment.

Please find below consultation information for the Okha Operations Environment Plan.

Would be great to meet if you now have carriage of this work?

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

Email to DPIRD – 15 August 2019

Hi [redacted]– I'm following up on my email of 8 July to [redacted] and yourself regarding Woodside's consultation information for the Okha Operations Environment Plan.

Should you have any queries or comments please let me know.

I'd be happy to meet you now Carli has moved into a different role.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

Email to State fishery licence holders – 8 July 2019

Dear Fishery Licence Holder

Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to as low as reasonably practical (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.

An information sheet (also available on our website) and maps of State Fisheries relevant to the proposed activities are also attached.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
State fisheries consulted for this activity*:	• Pilbara Trawl Fishery • Pilbara Trap Fishery • Pilbara Line Fishery • Mackerel Fishery
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line. • A 500 m radius Operational Area around four suspended exploration wells.

* 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

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	• The presence of the Okha FPSO and subsea infrastructure may result in exclusion of other users, or interactions between vessels and the facility.	• Woodside will implement a 500 m petroleum safety zone around the Okha FPSO to reduce the likelihood of interactions. • Notification and updates to 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 may occur due to the physical presence of the Okha FPSO and subsea infrastructure and subsea inspection, maintenance and repair (IMR) activities.	• Woodside will seek to minimise seabed disturbance during Okha FPSO operations through: o The use of vessels with dynamic positioning for IMR. o Monitoring and maintenance of subsea infrastructure to manage scour and flowline movement within integrity envelope.
Underwater noise	• Noise will be generated by the Okha FPSO, vessels, helicopters and IMR activities.	• Due to the low acoustic source levels associated with Okha FPSO and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges	• Operational discharges including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • Routine discharges of approved chemicals and residual hydrocarbons as a result of IMR activities. • Both 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. • Flushing of subsea infrastructure where practical to reduce volume of residual hydrocarbon discharged. • The produced water discharge is monitored and managed to achieve 99% species protection.
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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements being implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

Letter to State fishery licence holders – 8 July 2019

Woodside

Woodside Energy Ltd.
ACN 005 482 986
Mia Yellagonga
11 Mount Street
Perth WA 6000
Australia
T +61 8 9348 4000
F +61 8 9214 2777
www.woodside.com.au

[redacted]

8 July 2019

Dear Licence Holder

CONSULTATION INFORMATION – OKHA OPERATIONS ENVIRONMENT PLAN

Woodside is planning to submit a revised Operations Environment Plan for the Okha floating production storage and offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment in the development of the proposed Environment Plan for this activity. These risks are at Appendix A. Woodside has endeavoured to reduce these risks to as low as reasonably practical (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.

An information sheet (also available on our website) and maps of State Fisheries relevant to the proposed activities are also enclosed.

Activity purpose:	Support ongoing production from the Okha FPSO.
Activity:	The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	15 km North West of Dampier, Western Australia.
Facility location:	Latitude: 19° 35' 13" S Longitude: 116° 26' 29" E
Approximate water depth:	80 m
Exclusion zones:	A 500 m radius petroleum safety zone around the Okha FPSO. A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line A 500 m radius Operational Area around the four suspended exploration wells

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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the Environment Plan assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Kind Regards

[redacted]

APPENDIX A

Potential risks to commercial fishing

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	- The presence of the Okha FPSO and subsea infrastructure may result in exclusion of other users, or interactions between vessels and the facility.	- Woodside will implement a 500 m petroleum safety zone around the Okha FPSO to reduce the likelihood of interactions with the NRC. - Notification and updates to 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 may occur due to the physical presence of the Okha FPSO and subsea infrastructure and subsea maintenance, inspection and repair (IMR) activities.	- Woodside will seek to minimise seabed disturbance during Okha FPSO operations through:
		  - The use of vessels with dynamic positioning for IMR
		  - Monitoring and maintenance of subsea infrastructure to manage scour and flowline movement within integrity envelope.
		  -

Underwater noise	- Noise will be generated by the Okha FPSO, vessels, helicopters and IMR activities.	- Due to the low acoustic source levels associated with Okha FPSO and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges	- Operational discharges including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. - Routine discharges of approved chemicals and residual hydrocarbons as a result of IMR activities. - Both 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. - Flushing of subsea infrastructure where practical to reduce volume of residual hydrocarbon discharged. - The produced water discharge is monitored and managed to achieve 99% species protection.
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.

Email sent to PPA – 16 July 2019

Dear [redacted] – thank you for the chat.

As discussed Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to as low as reasonably practical (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.

An information sheet (also available on our website) and maps of State Fisheries (you'll note we haven't included Pearl Producers but please let me know if you consider them relevant given water depth and proximity to the Dampier Peninsula) relevant to the proposed activities are also attached.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
State fisheries consulted for this activity*:	• Pilbara Trawl Fishery • Pilbara Trap Fishery • Pilbara Line Fishery • Mackerel Fishery • Pearl Producers Association
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line.

	• A 500 m radius Operational Area around four suspended exploration wells.

* 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

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	• The presence of the Okha FPSO and subsea infrastructure may result in exclusion of other users, or interactions between vessels and the facility.	• Woodside will implement a 500 m petroleum safety zone around the Okha FPSO to reduce the likelihood of interactions. • Notification and updates to 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 may occur due to the physical presence of the Okha FPSO and subsea infrastructure and subsea inspection, maintenance and repair (IMR) activities.	• Woodside will seek to minimise seabed disturbance during Okha FPSO operations through: • The use of vessels with dynamic positioning for IMR. • Monitoring and maintenance of subsea infrastructure to manage scour and flowline movement within integrity envelope.
Underwater noise	• Noise will be generated by the Okha FPSO, vessels, helicopters and IMR activities.	• Due to the low acoustic source levels associated with Okha FPSO and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.

Marine discharges	• Operational discharges including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • Routine discharges of approved chemicals and residual hydrocarbons as a result of IMR activities. • Both 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. • Flushing of subsea infrastructure where practical to reduce volume of residual hydrocarbon discharged. • The produced water discharge is monitored and managed to achieve 99% species protection.
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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

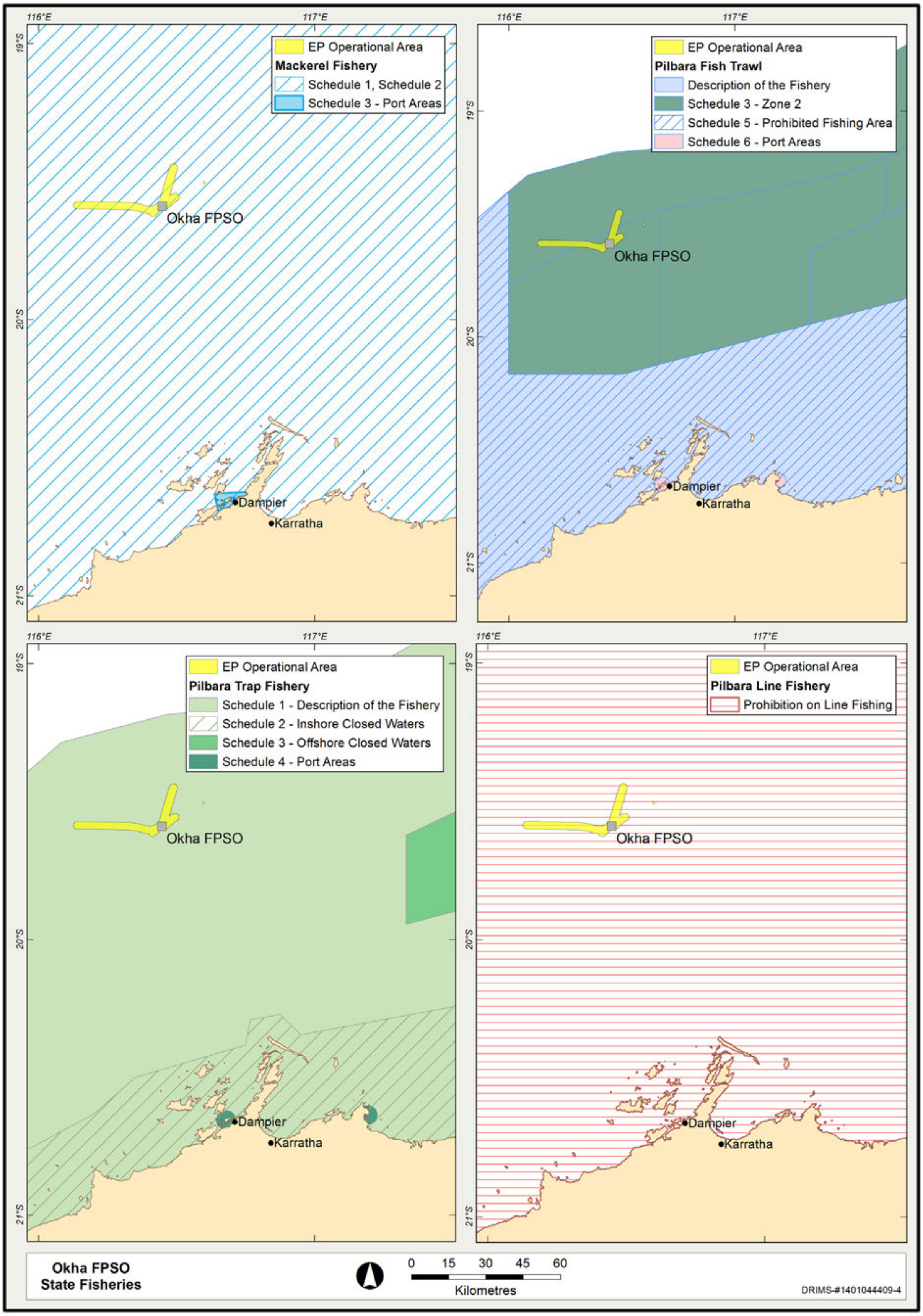
Please note under public transparency arrangements being implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

State Fishery map provided to DPIRD, WAFIC and fishing licence holders – 8 July 2019
State Fishery map provided to PPA – 16 July 2019



Email to AMSA – 8 July 2019

Dear AMSA

Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

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 shipping densities map is also attached for your reference.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line. • A 500 m radius Operational Area around four suspended exploration wells.

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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

Email to AHO – 8 July 2019

Dear AHO

Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

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 shipping densities map is also attached for your reference.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line. • A 500 m radius Operational Area around four suspended exploration wells.

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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

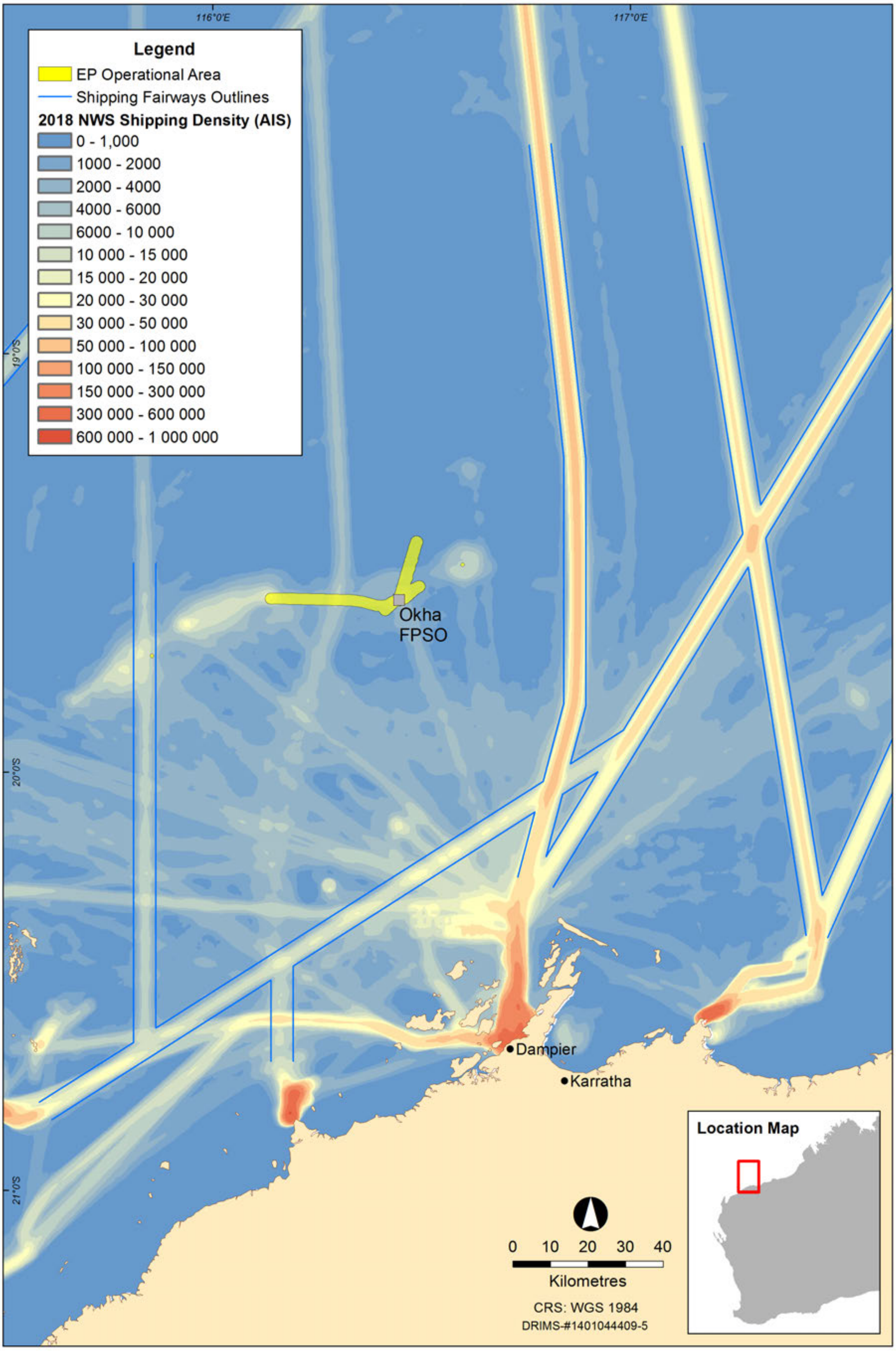
Please provide your views by close of business **7 August 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

[redacted]

Shipping lane map provided to AMSA and AHO – 8 July 2019



Email to adjacent titleholders – 8 July 2019

Dear Stakeholder

Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

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 neighbouring Titleholders map is also attached.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line. • A 500 m radius Operational Area around four suspended exploration wells.

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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

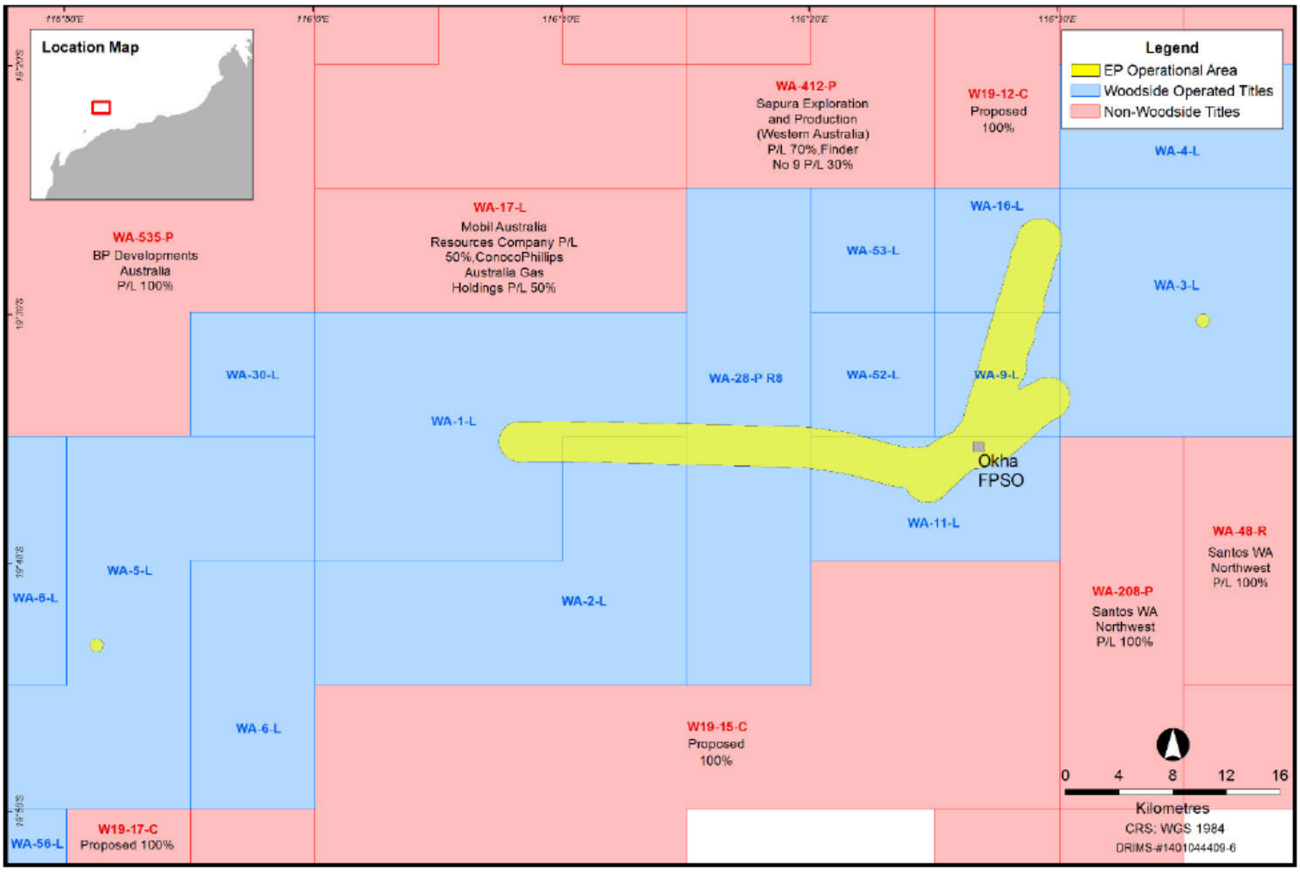
Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

Titleholders map provided to BP Developments, Mobil Australia, Santos and Sapura Exploration and Petroleum – 8 July 2019



Email to DAWR – 2 August 2019

Dear Department of Agriculture and Water Resources (DAWR)

Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last accepted by NOPSEMA on 10 December 2014.

With respect to DAWR's guidance for consultation on Environment Plans and Offshore Project Proposals - please note the following points below. An Information Sheet is attached and is also available on our website.

Activity overview

Activity purpose:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
Operational Area:	• A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line • A 500 m radius Operational Area around four suspended exploration wells

Commercial fishing
Whilst three Commonwealth Fisheries overlap the proposed Operational Area (see attached map), it is our assessment that interaction with licence holders in Commonwealth Fisheries is unlikely, as fishing effort has historically taken place well beyond the operational area.

Biosecurity
With respect to the biosecurity matters, please note the following information below.

Vessels:	• Two types of vessels service the offshore facility including: o Platform support vessels o Subsea support vessels • All support 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 Okha facility is flat and featureless with no areas of hard substrate or outcrops. The seabed composition is characterised by deep (>5 m) soft silty sediment.
	• The closest distance to the Marine Parks are;
	  o Approximately 120 km north west of the Montebello Islands Marine Park (WA)
	  o Approximately 72 km north west of Montebello Marine Park - Multiple Use Zone (Cwlth)

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 is appreciated by **1 September 2019** to assist with planning for this activity, noting that your feedback and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth). Comments can be made by email, letter or by phone.

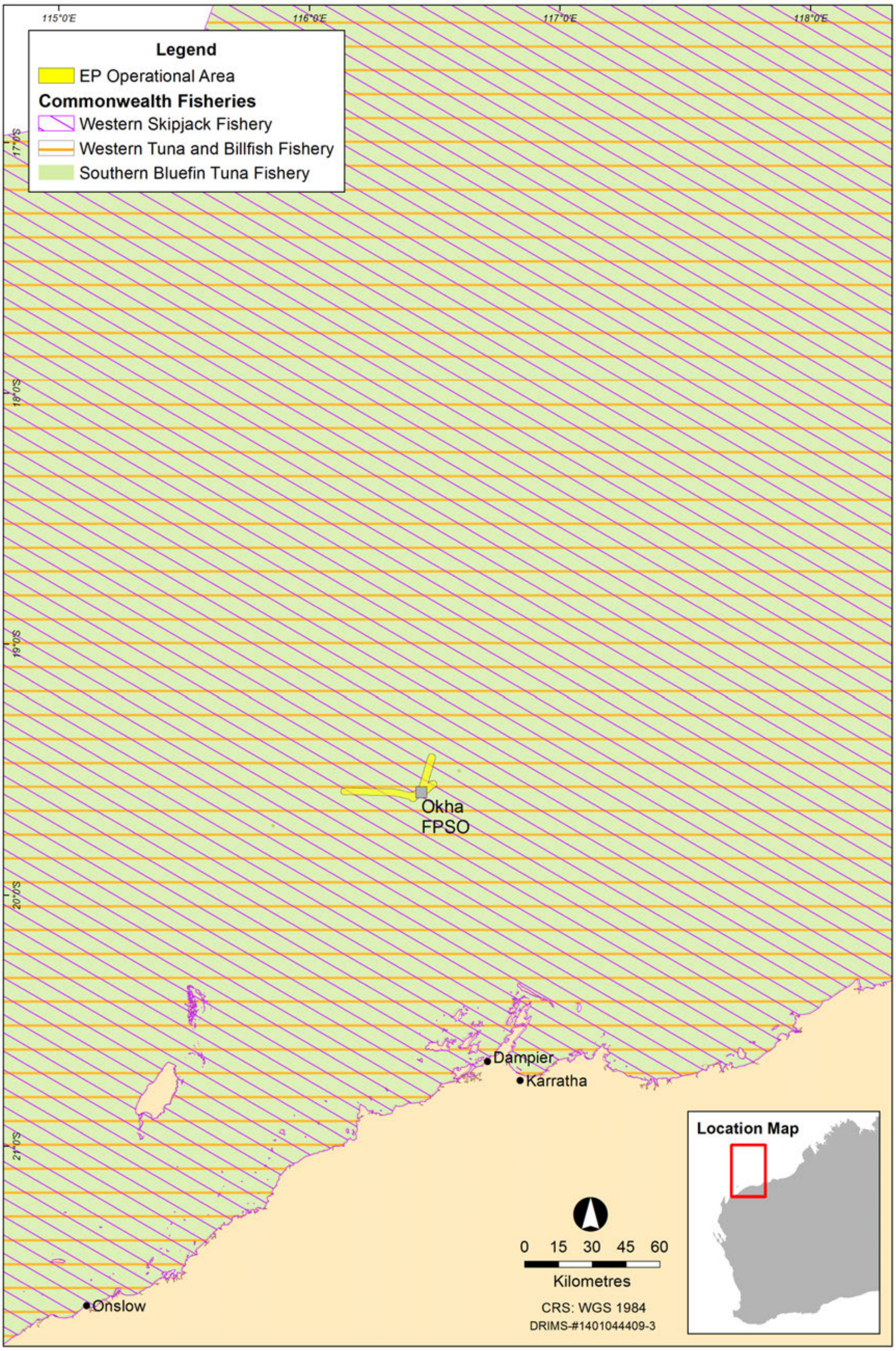
In line with Australian Government guidance on consultation with government agencies, can you also please advise within 10 business days if you require any additional information on the proposed activity.

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Regards

[redacted]
Corporate Affairs Adviser | Corporate Affairs
Woodside Energy Ltd

Commonwealth Fishery map provided to DAWR – 2 August 2019



Email sent to DNP – 20 September 2019

Dear Director of National Parks

Woodside is submitting a revised Environment Plan for the Okha Floating Production, Storage and Offloading (FPSO) facility in accordance with Commonwealth environmental regulations, which require Environment Plans for operating facilities to be revised at least every five years.

The Okha FPSO is located in Commonwealth waters about 115 km north west of Dampier Western Australia and extracts, processes, stores and offloads oil and export gas from the Cossack, Wanaea, Lambert and Hermes fields.

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 the nearest being Montebello Marine Park, 35 km to the south west of the Operational Area.
- 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 consequence 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 and mitigate their consequences, it is considered that the risk associated with a subsea well blow out is managed to as low as reasonably practical.
- In the unlikely event of a loss of well control there is a risk of light crude entering the following Marine Parks:
    - Montebello Marine Park
    - Argo-Rowley Terrace Marine Park
    - Gascoyne Marine Park
    - Ningaloo Marine Park
    - Shark Bay Marine Park

A Commonwealth Government-approved oil spill response plan will be in place for the duration of the activities, which includes notification to relevant agencies and organisations as to the nature and scale of the event, as soon as practicable following an occurrence. The Director of National Parks will be advised if an environmental incident occurs that may impact on the values of 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 21 October 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

Email to DNP – 26 June 2020

Dear Director of National Parks

Based on recent assessment feedback received from NOPSEMA on the Okha Operations 5 Year Resubmission Environment Plan, Woodside is updating the Environment Plan to include further detail on the Australian Marine Parks which may be contacted by an oil spill at the 10 parts per billion (ppb) threshold for dissolved and entrained hydrocarbons, in line with the NOPSEMA Bulletin (https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf). Previously Woodside consulted based on the higher ecological threshold being applied.

As required via previous consultation, the Environment Plan currently details the requirement to notify the Director of National Parks in the event of a spill with any potential to contact an Australian Marine Park. Through the consideration of the 10 ppb threshold the following AMPs may be contacted in the event of a spill:

- Montebello
- Argo-Rowley Terrace
- Gascoyne
- Ningaloo
- Shark Bay
- Cartier Island
- Kimberley
- Mermaid Reef
- Dampier
- Carnarvon Canyon
- Abrolhos Islands

These areas are encompassed in the Woodside Scientific Monitoring program (within the Scientific Monitoring Area, as described in the Environment Plan) which will be activated in the event of an oil spill.

As previously advised 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.

Please contact me if you have any queries about this updated information.

Regards

[redacted]

Oil Pollution Consultation

Woodside sent the emails below to stakeholders with responsibilities for oil pollution response in Commonwealth and State waters.

Email sent to DoT – 8 July 2019

Dear Stakeholder

Woodside is planning to submit a revised Operations Environment Plan for the Okha Floating Production Storage and Offloading (FPSO) facility in Production Licence WA-11-L in Commonwealth waters.

It is a requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations) that Environment Plans for operating facilities be revised at least every five years. The Environment Plan for this facility was last revised in November 2014.

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:	• Support ongoing production from the Okha FPSO.
Activity:	• The Okha FPSO will continue to produce oil for export from the facility via offloading tankers and gas for export to shore via a pipeline to the North Rankin Complex and then via two trunklines to the Karratha Gas Plant.
Activity location:	• 115 km North West of Dampier, Western Australia.
Facility location:	• Latitude: 19° 35' 13" S • Longitude: 116° 26' 29" E
Approximate water depth:	• 80 m
Exclusion zones:	• A 500 m radius petroleum safety zone around the Okha FPSO. • A 1500 m radius Operational Area around the Okha FPSO, subsea infrastructure, including wells and flowlines and the gas export line. • A 500 m radius Operational Area around four suspended exploration wells.

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 (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Please provide your views by close of business **7 August 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

Email sent to DoT – 27 August 2019

Good Afternoon [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 *Okha FPSO Facility Operations 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, located about 115 km north-west of Dampier. The FPSO activities form part of the ongoing production from 13 subsea production wells tied back to the Okha FPS0, 10 of which are capable of producing hydrocarbons.

- The *Okha FPSO Facility Operations Oil Pollution Emergency 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 18 October 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 9 October 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.

[redacted]

Information Requested in the Offshore Petroleum Industry Guidance Note (September 2018)	Information Provided & Reference	
Description of activity, including the intended schedule, location (including coordinates), distance to nearest landfall and map.	Included in the consultation information sheet	
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 Cossack Light Crude indicates that average dispersant efficiency (%) for oil age will be; • ~45% (0 hours) • ~84% (<12 hrs) • ~16% (48-96 hrs) This data is based on a range of weathering results and five National Plan OSCA approved and/or transitional dispersants that will be the most likely dispersants 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 5 of the EP). Further descriptions of risk, impacts and mitigation measures (which are not related to hydrocarbon preparedness and response) are provided in Section 5 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 EP 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	Minimum time to shoreline accumulation	14.2 days (Barrow Island – 2 m^3)

times to enter State waters and contact shorelines.	(above 100 g/m2) at any individual shoreline receptor (loss of well containment – MEE-01)	
	Minimum time to shoreline accumulation (above 100 g/m2) where largest shoreline accumulation (above 100g/m2) across all shoreline receptors (loss of well containment – MEE-01)	42 days (Pilbara Islands – Southern Islands Group – 65.8 m^3)
	Minimum time to shoreline accumulation (above 100 g/m2) at any individual shoreline receptor (cargo tank rupture – MEE-05)	7 days (Barrow Island, 42 m^3)
	Minimum time to shoreline accumulation (above 100 g/m2) where largest shoreline accumulation (above 100g/m2) across all shoreline receptors (cargo tank rupture – MEE-05)	11 days (Montebello Islands and Montebello Islands State Marine Park – 110 m^3)
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.	• 1 x Level 1 oil spill response drill to be conducted per year. This drill should test elements of the recommended response identified in the NRC Oil Pollution First Strike Plan in relation to the level of the incident. • 1x Crisis oil spill response focused exercise annually. **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 be advised maps showing surface oil concentrations from Loss of well containment and loss of cargo tank containment (Section 4) and Dispersant Application (Section 5) are still being finalised.

[redacted]
Hydrocarbon Spill Adviser | Security & Emergency Management

Email sent to DoT – 16 September August 2019

Good Afternoon [redacted],

For your records please find attached the updated First Strike Plan with maps showing surface oil concentrations from Loss of well containment and loss of cargo tank containment (Section 4) and Dispersant Application (Section 5) included.

If you have any questions please don't hesitate to get in touch.

Kind Regards

[redacted]

Email sent to AMSA (marine pollution) – 27 August 2019

Good Evening [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 *Okha FPSO Facility Operations 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, located about 115 km north-west of Dampier. The FPSO activities form part of the ongoing production from 13 subsea production wells tied back to the Okha FPS0, 10 of which are capable of producing hydrocarbons.

- The *Okha FPSO Facility Operations Oil Pollution Emergency 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 be advised maps showing surface oil concentrations from Loss of well containment and loss of cargo tank containment (Section 4) and Dispersant Application (Section 5) are still being finalised.

Woodside propose to submit an EP 18 October 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 9 October 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.

Regards,
[redacted]

[redacted]
Hydrocarbon Spill Adviser | Security & Emergency Management
Woodside Energy Ltd

APPENDIX E NOPSEMA REPORTING FORMS

Recordable Environmental Incident Monthly Report

NOPSEMA

Due Date: By the 15th day of the following month.

Send completed form to: submissions@nopsema.gov.au via secure file transfer at https://securefile.nopsema.gov.au/filedrop/submissions

Reference: Regulation 26B

Please check the following boxes if applicable to this report		Nil Incident Report: ☐		Final report for this activity: ☐	
Titleholder name:		**Titleholder business address:**		**Title of environment plan for the activity:**	
Activity type: (e.g. drilling, seismic, production)		**Month, Year:**		**Facility name and type:** (e.g. MODU, Seismic Vessel, FPSO)	
Contact person:		**Email:**		**Phone:**	
Incident date	**All material facts and circumstances** (including release volumes to environment if applicable)	**Performance outcome(s) and/or standard(s) breached**	**Action taken to avoid or mitigate any adverse environmental impacts of the incident**	**Corrective action taken, or proposed, to stop, control or remedy this incident**	**Action taken, or proposed, to prevent a similar incident occurring in future**

Note 1: As at 28 February 2014, amendments to the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations changed from environmental performance objective to environmental performance outcome. If you are reporting against an EP accepted under the old Regulations please report against the environmental performance objective for that activity.

Note 2: This form may be submitted in conjunction with the 'Injuries and Fatalities – Monthly Summary Report' Form available at www.nopsema.gov.au

Privacy Notice

NOPSEMA collects your contact details for the purpose of administering the OPGGSA and associated regulations. NOPSEMA will not use or disclose your personal information for any other purpose without your consent, unless it is required or authorised by law, or relates to NOPSEMA's enforcement activities. Your personal information may be disclosed to the following organisations, entities or individuals:

- individuals who make a request under the *Freedom of Information Act 1982*
- the Australian National Audit Office and other privately-appointed auditors
- NOPSEMA's legal advisors.

Report of an accident, dangerous occurrence or environmental incident

For instructions and general guidance in the use of this form, please see the last page.

Part 1 is required within 3 days of a notified incident.
Part 2 is required within 30 days of notified incident.

What was the date and time of the initial verbal incident notification to NOPSEMA?			
Date		**Time**	

NOTE: It is a requirement to request permission to interfere with the site of an accident or dangerous occurrence. Refer OPGGS(S)R, Reg. 2.49.

What is the date and time of this written incident report?			
Date		**Time**	

What type of incident is being reported?	*Please tick appropriate incident type*	
Accident or dangerous occurrence		Complete parts 1A, 1B & part 2
Environmental Incident		Complete parts 1A, 1C
BOTH (Accident or dangerous occurrence AND environmental incident)		Complete ALL parts (1A, 1B, 1C, 2)

Please tick all applicable (one or more categories) *To use electronically: MS Word 2007-10 – click in check box*

Categories *Please select one or more*	Accidents	Death or Serious injury	☐
		Lost time injury ≥3 days	☐
	Dangerous occurrences	Hydrocarbon release >1 kg or ≥80 L (gas or liquid)	☐
		Fire or explosion	☐
		Collision marine vessel and facility	☐
		Could have caused death, serious injury or LTI	☐
		Damage to safety-critical equipment	☐
		Unplanned event - implement ERP	☐
		Pipeline incident	☐
		Well kick >50 barrels	☐
		Other ____________________	☐
	Environmental incidents	Hydrocarbon release	☐
		Chemical release	☐
		Drilling fluid/mud release	☐
		Fauna Incident	☐
		Other ____________________	☐

Part 1A – Information required within 3 days of an accident, dangerous occurrence or environmental incident

General information – all incidents

1.	**Where did the incident occur?**	Facility / field / title name		
		Site name and location *Latitude/longitude*		
2.	**Who is the registered operator/titleholder or other person that controls the works site or activity?**	Name		
		Business address		
		Business phone no.		
3.	**When did the incident occur?**	Time and time zone		
		Date		
4.	**Did anyone witness the incident?**	Yes or no *If yes, provide details below*		
	Witness details	Witness no 1	Witness no 2	Witness no 3
	Full name			
	Phone no. (Business hours)			
	Phone no. (Home) (Mobile)			
	Email (Business) (Private)			
	Postal address			
	NB: If more witnesses, copy and insert this section (4) here , and add extra witness numbers appropriately			
5.	**Details of person submitting this information**	Name		
		Position		
		Email		
		Telephone no.		
6.	**Brief description of incident**			
7.	**Work or activity being undertaken at time of incident**			

Part 1A – Information required within 3 days of an accident, dangerous occurrence or environmental incident

General information – all incidents

8.	**What are the internal investigation arrangements?**					
9.	**Was there any loss of containment of any fluid (liquid or gas)?**	Yes or no *If Yes, provide details below*				
		Type of fluid (liquid or gas) *If hydrocarbon release please complete item no.15 as well*	Hydrocarbon ☐ *Please specify*________		Non-hydrocarbon ☐ *Please specify*________	
		Estimated quantity *Liquid (L), Gas (kg)*				
		Estimation details	Calculation	☐	Measurement	☐
			*Please specify*________			
		Composition *Percentage and description*				
		Known toxicity to people and/or environment	Toxicity to people			
			Toxicity to environment			
		How was the leak/spill detected?	F&G detection	☐	Visual	☐
			CCTV	☐	Other	☐
		Did ignition occur?	No	☐	Immediate	☐
			Yes	☐	Delayed	☐
			If yes, what was the likely ignition source		Hotwork	☐
					Spark electrical source	☐
					Spark metallic contact	☐
					Hot surface	☐
					Other	☐
10.	**Has the release been stopped and/or contained?**	Yes or no				
		Duration of the release *hh:mm:ss*				
		Estimated rate of release *Litres or kg per hour*				
11.	**Location of release**	What or where is the location of the release?				
		What equipment was involved in the release?				
		Is this functional location listed as safety-critical equipment?				

Part 1A – Information required within 3 days of an accident, dangerous occurrence or environmental incident

General information – all incidents

12.	**Weather conditions** *Please complete as appropriate*	Ambient temperature C°	
		Relative humidity %	
		Wind speed m/s *NB: for enclosed areas use* Air change per hour	
		Wind direction e.g. from SW	
		Significant wave height m	
		Swell m	
		Current speed m/s	
		Current direction e.g. from SW	
13.	**Hydrocarbon release details** *If hydrocarbon fluid (liquid or gas) was released, please complete this section as well*	System of hydrocarbon release	Process ☐ Drilling ☐ Subsea / Pipeline ☐ Utilities ☐ Well related ☐ Marine ☐
		Estimated inventory in the isolatable system *Litres or kg*	
		System pressure and size of piping or vessel *diameter (d in mm)* *length (l in m)* *or volume (V in L)*	Pressure MPag:
			Size Piping (d) and Piping (l) or Vessel (V):
		Estimated equivalent hole diameter *d in mm*	

Part 1B - Complete for accidents or dangerous occurrences

Accidents and dangerous occurrences information

	Was NOPSEMA notified through the dedicated notification phone line? *Phone No. 08 6461 7090*		Yes	☐	No	☐
15.	**Action taken to make the work-site safe**	Was permission given by a NOPSEMA inspector to interfere with the site?				
		OPGGS(S)R 2.49.	Yes	☐	No	☐
		Action taken				
		Details of any disturbance of the work site				

Part 1B - Complete for accidents or dangerous occurrences

Accidents and dangerous occurrences information

16.	**Was an emergency response initiated?**		Yes	☐	No	☐
		Type of response	Manual Automatic alarm	☐ ☐	Muster Evacuation	☐ ☐
		How effective was the emergency response?				

17.	**Was anyone killed or injured?** *Provide details below*		Yes	☐			No	☐
	Injured persons (IP)	**Casualty No 1**						
	If different from item 2. Employer name		Employer address					
	Employer phone no.		Employer email					
	IP full name							
	IP date of birth		Sex	M	☐	F	☐	
	IP residential address							
	IP phone no. (Work)		IP phone no. (Home) (Mobile)					
	IP occupation/job title		Contractor or core crew					
	Details of injury							
	Based on TOOCS (refer last page) Nature of injury	a. Intracranial injury b. Fractures c. Wounds, lacerations, amputations, internal organ damage	☐ ☐ ☐	d. Burn e. Nerve or spinal cord injury f. Joint, ligament, muscle or tendon injury g. Other ____________	☐ ☐ ☐ ☐			
	Part of body	G1. Head or face G2. Neck G3. Trunk G4. Shoulder or arm	☐ ☐ ☐ ☐	G5. Hip or leg G6. Multiple locations G7. Internal systems G8. Other ____________	☐ ☐ ☐ ☐			
	Mechanism of injury	G0. Falls, stepping, kneeling, sitting on object G1. Hitting object G2. Being hit or trapped	☐ ☐ ☐	G3. Exposure to sound or pressure G4. Muscular stress G5. Heat, cold or radiation G6/7 Chemical, biological substance G8. Other ____________	☐ ☐ ☐ ☐ ☐			
	Agency of injury	1. Machinery or fixed plant 2. Mobile plant or transport 3. Powered equipment 4. Non-power equipment	☐ ☐ ☐ ☐	5/6. Chemicals, materials, substances 7. Environmental agencies 8. Human or animal agencies 9. Other ____________	☐ ☐ ☐ ☐			

Part 1B - Complete for accidents or dangerous occurrences

Accidents and dangerous occurrences information							
	Details of job being undertaken						
	Day and hour of shift	Day *e.g. 5th day of 7 (5 / 7)*		Hour *e.g. 3rd hour of 12 (3 / 12)*			
	NB: If more casualties, please copy/paste this section (19) for each additional casualty and insert here						
18.	**Was there any serious damage?** *Provide details below*		Yes	☐	No	☐	
	Details	**Item 1**	**Item 2**		**Item 3**		
	Equipment damaged						
	Extent of damage						
19.	**Will the equipment be shut down?** *Yes or No*						
	If Yes, for how long?						
	NB: If more equipment seriously damaged, please copy/paste this section as required						
20.	**Will the facility be shut down?**	Yes or no *If yes provide details below*					
	Facility shutdown	Date		dd/mm/yyyy			
		Time		24 hour clock			
		Duration		days / hours / minutes			
21.	**Immediate action taken/intended, if any, to prevent recurrence of incident.**	**Action**	**Responsible party**	**Completion date** *Actual or intended*			
22.	**What were the immediate causes of the incident?**						

Attachments

Are you attaching any documents?			Yes or no *If yes provide details below*	
No.	**ID**	**Revision**	**Date**	**Title/description**

Attachments

Are you attaching any documents?			Yes or no *If yes provide details below*	

Insert or delete rows as required

Part 1C – Complete for environmental incidents

Environmental Impacts

23.	What is the current environment plan for this incident?	Environment plan			
24.	Has the incident resulted in an impact to the environment?	Yes or no *If yes provide details below*			
		Incident details *e.g. estimated area of impact, nature/significance of impact*			
		ENVIRONMENTAL RECEPTORS			
		Open ocean ☐ Shoreline ☐ Population centre ☐ Stakeholders ☐ Other sensitivity ☐ *e.g. conservation area, nesting beach*	Macroalgae ☐ Coral Reef ☐ Benthic invertebrates ☐ Seagrass ☐ Mangrove ☐		
		Further details			
	Details	**Environment 1**	**Environment 2**	**Environment 3**	
	Location of receiving environments *Lat/Long*				
	Date & time of impact				
	Action taken to minimise exposure				
	Specify each matter protected under Part 3 of the EPBC Act impacted				
	NB: If more environments were damaged, please copy/paste this section (Item E3) and add extra data				
25.	**Are any environments at risk?** *Including as a result of spill response measures*	Yes or no *If yes, provide details*			
		Details *e.g. zone of potential impact*			
		AT RISK ENVIRONMENTS			

Part 1C – Complete for environmental incidents

Environmental Impacts

		Open ocean ☐ Shoreline ☐ Population Centre ☐ Stakeholders ☐ Other sensitivity ☐ *e.g. conservation area, nesting beach*		Macroalgae ☐ Coral Reef ☐ Benthic Invertebrates ☐ Seagrass ☐ Mangrove ☐	
	Details	**Environment 1**	**Environment 2**	**Environment 3**	
	Estimated location of 'at-risk' environments				
	Estimated impact date & time				
	Action required to minimise exposure				
	Specify each matter protected under Part 3 of the EPBC Act at risk				
	NB: If more environments at risk of damage, please copy/paste this section (Item E2) and add extra data				
26.	**Was an oil pollution emergency plan activated?**	Yes or no			
		If yes, what action has been implemented /planned?			
		If yes, how effective is/was the spill response?			
27.	**Was an environmental monitoring program initiated?**	Yes or no			
		If yes, what actions have been implemented and/or planned?			
28.	**Did the incident result in the death or injury of any fauna?**	Yes or no (If yes provide details of species in the table below)			
	Injured fauna	**Species 1**	**Species 2**	**Species 3**	
	Species name (common or scientific name)				
	Number of individuals killed or injured	Killed: Injured:	Killed: Injured:	Killed: Injured:	
	NB: If more species were injured or killed, please copy/paste this section (Item E4) and add extra data				
29.	**Actions taken to avoid or mitigate any adverse environmental impacts of the incident.**	**Action**	**Responsible party**	**Completion date** *Actual or intended*	
	NB: If more actions, please add extra rows as required				

Part 1C – Complete for environmental incidents

Environmental Impacts

30.	Corrective actions taken, or proposed, to stop, control or remedy the incident.	**Action**	**Responsible party**	**Completion date** *Actual or intended*
	NB: If more actions, please add extra rows as required			
31.	Actions taken, or proposed, to prevent a similar incident occurring in the future.	**Action**	**Responsible party**	**Completion date** *Actual or intended*
	NB: If more actions, please add extra rows as required			

Attachments

Are you attaching any documents?			Yes or no *If yes provide details below*	
No.	**ID**	**Revision**	**Date**	**Title/Description**
Insert or delete rows as required				

Part 2 – Information required within 30 days of accident or dangerous occurrence

NOPSEMA acknowledges that in many circumstances an operator may not have completed an investigation within 3 days of an accident or first detection of a dangerous occurrence and agrees that these items must be provided within 30 days unless otherwise agreed, in writing with NOPSEMA. In circumstances where an investigation has been completed within 3 days, and these items are available (supplemented, as required by any attachments) this part should also be completed at that time.

32.	**Has the investigation been completed?**	Yes or no		
	Root cause analysis *What were the root causes?*	Root cause 1		
		Root cause 2		
		Root cause 3		
		Other root causes		
	Full report *Describe investigation in detail, including who conducted the investigation and in accordance with what standard/procedure with reference to attachments listed in the 'attachments table' (following) as applicable*			
33.	**Actions to prevent recurrence of same or similar incident**	**Action**	**Responsible party**	**Completion date** *Actual or intended*
	NB: Add or delete rows as appropriate			

Attachments (Insert/delete rows as required)

Are you attaching any documents?			Yes or no *If yes provide details below*	
No.	**ID**	**Revision**	**Date**	**Title/description**

Instructions and general guidance for use:

1. The use of this form is voluntary and is provided to assist operators and titleholders to comply with their obligations to give notice and provide reports of incidents to NOPSEMA under the applicable legislation.
2. Accidents, dangerous occurrences or environmental incidents can all be reported using this same form.
3. The applicable legislation for incident reporting is:
   a. Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 [OPGGS(S)R]; and
   b. Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 [OPGGS(E)R], for facilities located in Commonwealth waters; or
   c. for facilities located in designated coastal waters, the relevant State or Territory Act and associated Regulations where there is a current conferral of powers to NOPSEMA.
4. In the context of this form an incident is a reportable incident as defined under:
   a. OPGGSA, Schedule 3, Clause 82.
   b. OPGGS(E)R, regulation 4.
5. This form should be used in conjunction with NOPSEMA Guidance Notes available on the NOPSEMA website:
   a. N-03000-GN0099 Notification and Reporting of Accidents and Dangerous Occurrences
   b. N-03000-GN0926 Notification and Reporting of Environmental Incidents
6. Part 1 requires completion for all incidents; then ALSO complete part 2 if the incident is an accident or dangerous occurrence.
7. NOPSEMA considers that a full report will contain copies of documentary material referenced and/or relied on in the course of completing this form, which may include (but not be limited to) as appropriate: witness statements, management system documents, drawings, diagrams and photographs, third party reports (audit, inspection, material analysis etc.), internal records and correspondence.
8. This form is intended to be completed electronically using Microsoft Word by completing the unshaded cells which will expand as required to accept the information required and the check boxes where relevant (NB: check boxes may appear shaded and have reduced functionality in MS Word versions prior to 2010).
9. The completed version of this form (and any attachments, where applicable) should be emailed to: submissions@nopsema.gov.au or submitted via secure file transfer at: https://securefile.nopsema.gov.au/filedrop/submissions as soon as practicable, but in any case within three days of the incident.

References

NOPSEMA website: www.nopsema.gov.au

TOOCS – Type of Occurrence Classification System.

The *Type of Occurrence Classifications System, Version 3.0* (TOOCS3.0) was developed to improve the quality and consistency of data. This system aligns with the International Classification of Diseases –Australian Modification (ICD10-AM).

http://www.safeworkaustralia.gov.au/sites/SWA/AboutSafeWorkAustralia/WhatWeDo/Publications/Documents/207/TypeOfOccurrenceClassificationSystem(TOOCS)3rdEditionRevision1.pdf

OPGGS(S)R. Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009. Select Legislative Instrument 2009 No. 382 as amended and made under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006.*Commonwealth of Australia.

OPGGS(E)R. Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009. Statutory Rules 1999 No. 228 as amended and made under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006.* Commonwealth of Australia.

Privacy Notice

NOPSEMA collects your personal information for the purpose of investigating accidents, dangerous occurrences and environmental incidents under the Offshore Petroleum and Greenhouse Gas Storage Act 2006.

NOPSEMA will not use or disclose your personal information for any other purpose without your consent, unless it is required or authorised by law, or relates to NOPSEMA's enforcement activities. Your personal information may be disclosed to the following organisations, entities or individuals:

- individuals who make a request under the *Freedom of Information Act 1982*
- the Australian National Audit Office and other privately-appointed auditors
- other law enforcement bodies (for example, the police or the Coroner)
- NOPSEMA's legal advisors.

NOPSEMA may occasionally be required to disclose information to overseas recipients in order to discharge its functions or exercise its powers, or to perform its necessary business activities.

Information about how you can access, or seek correction to, your personal information is contained in NOPSEMA's APP Privacy Policy at www.nopsema.gov.au/privacy. If you have an enquiry or a complaint about your privacy, please contact NOPSEMA's Privacy Contact Officer on (08) 6188 8700 or by email at: privacy@nopsema.gov.au.

APPENDIX G DEPARTMENT OF PLANNING LAND, HERITAGE AND ABORIGINAL ENQUIRY SYSTEM RESULTS

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

30 Registered Aboriginal Sites in Coordinates - Area (OKHA EMBA Coordinates.xlsx) - 118.448767301°E, 15.5004033702°S (GDA94) : 118.553058665°E, 15.9319365834°S (GDA94) : 118.607820635°E, 16.3426866669°S (GDA94) : 118.493338657°E, 16.6292993925°S (GDA94) : 118.654330929°E, 16.9236376144°S (GDA94) : 118.840008832°E, 17.2275563355°S (GDA94) : 119.095967663°E, 17.6178082135°S (GDA94) : 119.321132727°E, 17.6300061935°S (GDA94) : 119.66936142°E, 17.5647021742°S (GDA94) : 120.010600524°E, 17.5008209562°S (GDA94) : 120.095294477°E, 17.1625169072°S (GDA94) : 120.067986618°E, 16.8066521475°S (GDA94) : 119.997667574°E, 16.4569983671°S (GDA94) : 119.954762224°E, 16.1028820033°S (GDA94) : 119.949971169°E, 15.7450803551°S (GDA94) : 119.973184724°E, 15.3888595903°S (GDA94) : 120.127141047°E, 15.1231771145°S (GDA94) : 120.052175845°E, 15.4994767872°S (GDA94) : 120.064916022°E, 15.8280794815°S (GDA94) : 120.1676823°E, 16.1506167562°S (GDA94) : 120.317638883°E, 16.4732228966°S (GDA94) : 120.457061847°E, 16.8010214912°S (GDA94) : 120.394792345°E, 17.1491794692°S (GDA94) : 120.26929958°E, 17.4481981246°S (GDA94) : 120.345901928°E, 17.9791073111°S (GDA94) : 120.151283997°E, 17.9694895299°S (GDA94) : 119.911512704°E, 18.074189153°S (GDA94) : 119.716978477°E, 18.4437510526°S (GDA94) : 119.432901717°E, 18.6603352642°S (GDA94) : 119.140375938°E, 18.8649257048°S (GDA94) : 118.809029232°E, 18.9979672932°S (GDA94) : 118.466131109°E, 19.0999033425°S (GDA94) : 118.075544885°E, 19.2816159173°S (GDA94) : 118.043737383°E, 19.7028297219°S (GDA94) : 117.904397887°E, 19.8550486198°S (GDA94) : 117.626014229°E, 20.0780872314°S (GDA94) : 117.184305384°E, 20.2056164428°S (GDA94) : 116.878070963°E, 20.2118448428°S (GDA94) : 116.806953869°E, 20.3406224798°S (GDA94) : 116.484368255°E, 20.4774663086°S (GDA94) : 116.266798566°E, 20.7295656518°S (GDA94) : 115.866409987°E, 20.8652247241°S (GDA94) : 115.598493078°E, 21.0978132753°S (GDA94) : 115.289601174°E, 21.2777503991°S (GDA94) : 114.990820028°E, 21.4514408036°S (GDA94) : 114.664653513°E, 21.7628653196°S (GDA94) : 114.302512539°E, 21.9376756947°S (GDA94) : 114.175975477°E, 21.9393534138°S (GDA94) : 114.170571°E, 21.789773°S (GDA94) : 113.954919°E, 21.944066°S (GDA94) : 113.718743076°E, 22.4928244365°S (GDA94) : 113. 635905877°E, 22.7166179288°S (GDA94) : 113.755760824°E, 22.8046304748°S (GDA94) : 113.762981118°E, 23.2374555226°S (GDA94) : 113.504161517°E, 23.2210318727°S (GDA94) : 113.170916302°E, 23.7075190953°S (GDA94) : 113.000326638°E, 24.0216217292°S (GDA94) : 112.699286687°E, 24.4403320905°S (GDA94) : 112.389665589°E, 24.63632295°S (GDA94) : 112.425275484°E, 24.3559690148°S (GDA94) : 112.189203436°E, 24.1675297817°S (GDA94) : 112.140175727°E, 23.8710283356°S (GDA94) : 112.078602161°E, 23.5189277126°S (GDA94) : 112.036811442°E, 23.0497352777°S (GDA94) : 111.835998684°E, 23.077038314°S (GDA94) : 111.637628979°E, 22.7963850869°S (GDA94) : 111.847446878°E, 22.5335089498°S (GDA94) : 111.900604168°E, 22.1561397899°S (GDA94) : 111.685796732°E, 22.0045575839°S (GDA94) : 112.005191481°E, 21.7986908017°S (GDA94) : 112.167608313°E, 21.4843289006°S (GDA94) : 112.488897826°E, 21.3357627434°S (GDA94) : 112.740721743°E, 20.991913603°S (GDA94) : 112.641281317°E, 20.7354837066°S (GDA94) : 112.442379576°E, 20.4388583613°S (GDA94) : 112.296420074°E, 20.2816664465°S (GDA94) : 112.339007091°E, 20.2106607486°S (GDA94) : 113.082198714°E, 20.4037770462°S (GDA94) : 113.239530828°E, 20.2829954694°S (GDA94) : 113.151311863°E, 19.9804947564°S (GDA94) : 113.407394097°E, 19.9911608867°S (GDA94) : 113.201449132°E, 19.6148311112°S (GDA94) : 113.010212178°E, 19.593304887°S (GDA94) : 113.281898038°E, 19.1892458065°S (GDA94) : 112.842041408°E, 18.7943652259°S (GDA94) : 113.096898299°E, 18.4930654543°S (GDA94) : 113.375121776°E, 18.6247015014°S (GDA94) : 113.518101893°E, 18.558260564°S (GDA94) : 113.228318009°E, 18.1611549189°S (GDA94) : 113.080418256°E, 18.4467328756°S (GDA94) : 113.011654936°E, 18.0470102751°S (GDA94) : 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15.9925884473°S (GDA94) : 114.282973603°E, 16.1775172221°S (GDA94) : 114.561592873°E, 16.4014324536°S (GDA94) : 114.996324247°E, 16.7985669745°S (GDA94) : 115.267298497°E, 16.6624071275°S (GDA94) : 115.485797989°E, 16.9130353839°S (GDA94) : 115.56688526°E, 16.7499792157°S (GDA94) : 115.949618463°E, 16.4259390056°S (GDA94) : 116.018458468°E, 16.2277012657°S (GDA94) : 116.196614248°E, 15.9194282733°S (GDA94) : 116.381281699°E, 15.6157213076°S (GDA94) : 116.69558851°E, 15.4528717742°S (GDA94) : 116.985441304°E, 15.2466121369°S (GDA94) : 117.322519346°E, 15.2234231986°S (GDA94) : 117.585286022°E, 15.4582536593°S (GDA94) : 117.918621061°E, 15.7270494788°S (GDA94) : 118.279102091°E, 15.64020179°S (GDA94) : 118.412113842°E, 15.3611815053°S (GDA94) : 118.583560184°E, 15.1082325006°S (GDA94) : 118.839494243°E, 14.8624315534°S (GDA94) : 119.135418686°E, 14.6621204917°S (GDA94) : 119.456831345°E, 14.4223206922°S (GDA94) : 119.219652674°E, 14.6285515635°S (GDA94) : 118.935650208°E, 14.8460116315°S (GDA94) : 118.723559802°E, 15.023817774°S (GDA94)

15.023817774°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.

Coordinate Accuracy
Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)
Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.
Status:
- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972.*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972.*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972.*

Access and Restrictions:
- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact heritageenquiries@dplh.wa.gov.au.
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- **Restrictions:**
  - **No Restrictions:** *Anyone* can view the information.
  - **Male Access Only:** Only *males* can view restricted information.
  - **Female Access Only:** *Only* females can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Basemap Copyright

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
508	POINT MURAT 03	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209042mE 7584688mN Zone 50 [Reliable]	P07503
509	POINT MURAT 04	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	208690mE 7584604mN Zone 50 [Reliable]	P07504
563	POINT MURAT 01	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	208716mE 7585665mN Zone 50 [Reliable]	P07501
564	POINT MURAT 02	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209079mE 7585539mN Zone 50 [Reliable]	P07502
628	CAMP THIRTEEN BURIAL	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	800392mE 7559449mN Zone 49 [Reliable]	P07434
873	MONTEBELLO IS: NOALA CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, BP Dating: 27,220 +/- 640	*Registered Knowledge Holder names available from DAA	348188mE 7741053mN Zone 50 [Reliable]	P07287
926	MONTEBELLO IS: HAYNES CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, Arch Deposit	*Registered Knowledge Holder names available from DAA	348289mE 7741005mN Zone 50 [Reliable]	P07286
6017	YARDIE CREEK CARAVAN BURIAL	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	191538mE 7576555mN Zone 50 [Unreliable]	P07115
6311	POINT MURAT.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Skeletal Material / Burial, Camp, Other: ?	*Registered Knowledge Holder names available from DAA	208538mE 7584405mN Zone 50 [Reliable]	P06628
6761	LOW POINT MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	802992mE 7566299mN Zone 49 [Reliable]	P06172
6762	MILYERING MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801342mE 7561449mN Zone 49 [Reliable]	P06173
6764	CAMP 17 SOUTH MIDDENS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	799042mE 7555649mN Zone 49 [Unreliable]	P06175

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6765	CAMP 17 NORTH MIDDENS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	799042mE 7555849mN Zone 49 [Unreliable]	P06176
6784	MANDU MANDU CREEK SOUTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	796642mE 7548649mN Zone 49 [Unreliable]	P06142
6785	MANDU MANDU CREEK NORTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	796642mE 7548649mN Zone 49 [Unreliable]	P06143
6801	NORTH T-BONE BAY	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801666mE 7562059mN Zone 49 [Reliable]	P06159
6827	CORAL BAY SKELETON	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	785143mE 7445149mN Zone 49 [Unreliable]	P06132
7126	MESA CAMP	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798442mE 7554749mN Zone 49 [Unreliable]	P05792
7206	WEALJUGOO MIDDEN.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Camp, Hunting Place	*Registered Knowledge Holder names available from DAA	776584mE 7504740mN Zone 49 [Reliable]	P05710
7265	LAKE SIDE VIEW	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	800942mE 7560549mN Zone 49 [Reliable]	P05664
7303	TULKI WELL MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798642mE 7554249mN Zone 49 [Reliable]	P05649
7305	MANGROVE BAY.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Skeletal Material / Burial, Hunting Place	*Registered Knowledge Holder names available from DAA	804142mE 7568149mN Zone 49 [Reliable]	P05651
10381	VLAMING HEAD	Yes	Yes	No Gender Restrictions	Registered Site	Ceremonial, Mythological	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P01799
11400	YARDIE CREEK STATION	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	191638mE 7576655mN Zone 50 [Unreliable]	P00750

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
11401	5 Mile Well (Cape Range)	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Engraving, Painting, Quarry, Arch Deposit	*Registered Knowledge Holder names available from DAA	198638mE 7583655mN Zone 50 [Unreliable]	P00751
11820	ENDERBY ISLAND 01	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	445137mE 7725156mN Zone 50 [Unreliable]	P00364
11885	PADJARI MANU CAVE (Formerly Bunbury Cave)	Yes	Yes	No Gender Restrictions	Registered Site	Artefacts / Scatter, Ceremonial, Engraving, Painting, Arch Deposit, Water Source	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P00267
15322	POINT MURAT/WHITE OPAL	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209012mE 7585213mN Zone 50 [Reliable]	P07916
17447	PAP HILL OCHRE	No	No	No Gender Restrictions	Registered Site	Ceremonial, Grinding Patches / Grooves, Rockshelter, Ochre	*Registered Knowledge Holder names available from DAA	198327mE 7581741mN Zone 50 [Reliable]	
17448	CHUGORI ROCKHOLE	No	No	No Gender Restrictions	Registered Site	Ceremonial, Grinding Patches / Grooves, Man-Made Structure, Mythological, Water Source	*Registered Knowledge Holder names available from DAA	193492mE 7579323mN Zone 50 [Reliable]	

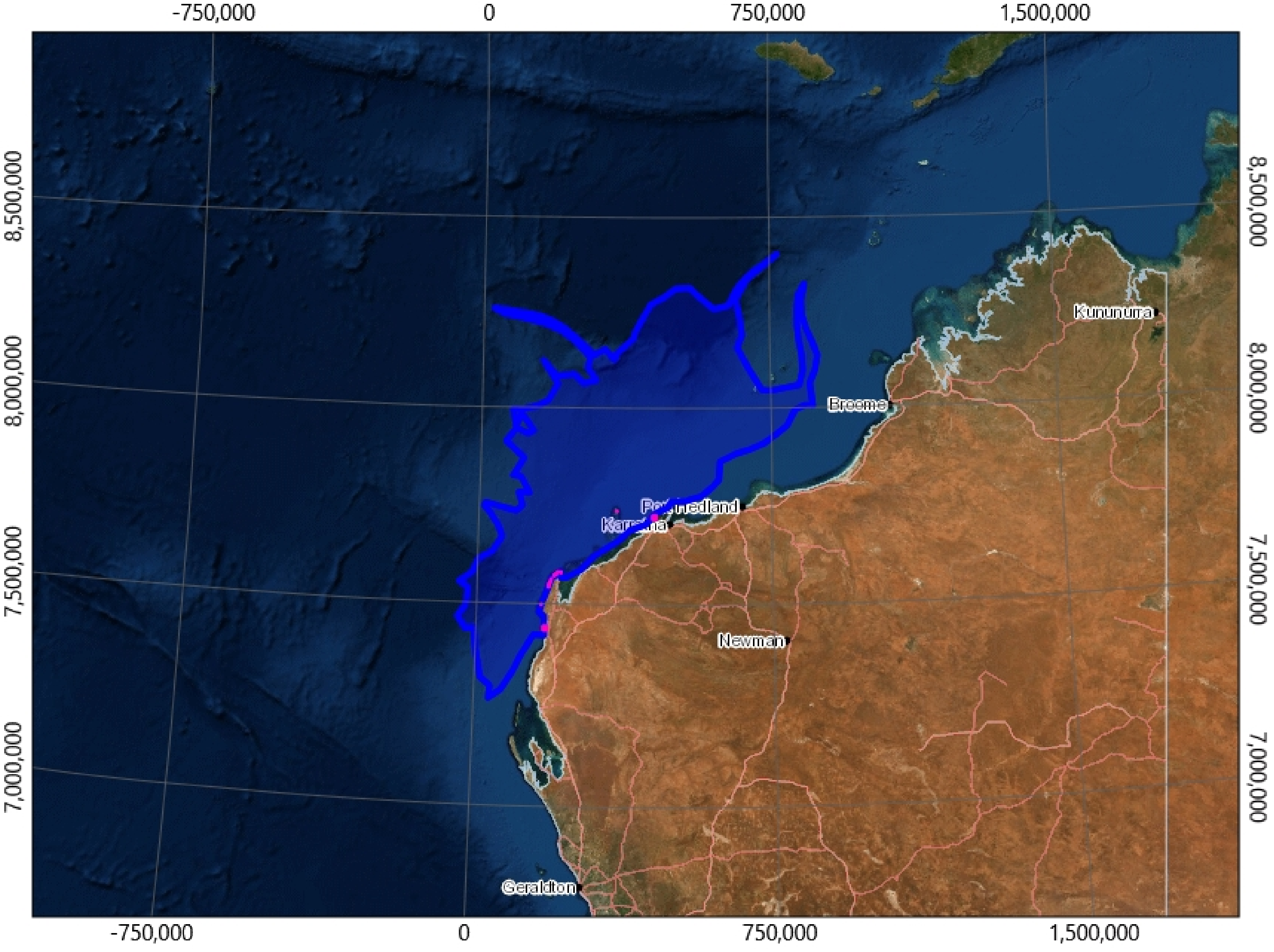
Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

For further important information on using this information please see the Department of Planning, Lands and Heritage's Disclaimer statement at https://www.dplh.wa.gov.au/about-this-website



Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

525.96 kilometres

Map Scale 1 : 15,940,000

MGA Zone 50 (GDA94)

Map created: 03/07/2019 12:06:59 PM by: GIS_NET_USER

Identifier: 401893

APPENDIX H OIL POLLUTION FIRST STRIKE PLAN

Okha Floating Production Storage and Offloading Facility Operations – Oil Pollution First Strike Plan

Security & Emergency Management
Hydrocarbon Spill Preparedness Unit

July 2020

Revision: 1

TABLE OF CONTENTS

OKHA FPSO FACILITY OPERATIONS

OIL POLLUTION FIRST STRIKE PLAN

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 & 3	WOODSIDE	CICC DUTY MANAGER
SPILL FROM FACILITY INCLUDING SUBSEA INFRASTRUCTURE ENTERING STATE WATERS	LEVEL 1	WOODSIDE	CICC DUTY MANAGER
	LEVEL 2 & 3	WA Department of Transport (DoT)	DoT IC
SPILL FROM VESSEL *(Note: SOPEP should be implemented in conjunction with this document)*	LEVEL 1	AMSA	VESSEL MASTER (with response assistance from Woodside)
	LEVEL 2 & 3	AMSA	AMSA (with response assistance from Woodside)

Oil Spill Incident Levels

The most significant characteristic of the below table is considered when determining oil spill incident 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.
Volumes	0-10 m^3.	10-1,000 m^3.	>1,000 m^3.

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 Western Australia 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 WA DoT will become the Control Agency for the response in State waters/shorelines only. WA DoT will appoint an Incident Controller (IC) and form a separate IMT 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 & 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 liaison officer resources to WA 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 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;

http://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf

Woodside's Incident Management Structure for a Hydrocarbon Spill, including Woodside Liaison Officer's command structure within DoT, can be seen at APPENDIX F – Woodside incident management structure.

Response Process Overview

Use the below to determine actions required and which parts of this plan are relevant to the incident.		
For guidance on credible scenarios and hydrocarbon characteristics, refer to **APPENDIX A – credible spill scenarios and Hydrocarbon Information**		
ALL INCIDENTS	Notify the Woodside Communication Centre (WCC) on: [redacted] 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: Level 1 Response Summary of this document. Remember to download each Operational Plan.	**Upon agreement with AMSA:** Coordinate pre-identified tactics in Table 2-1: Level 1 Response Summary 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: Level 2/3 Response Summary 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: Level 2/3 Response Summary 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 Okha FPSO Facility 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 Okha FPSO Facility 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 *Okha FPSO Facility Operations Environment Plan*.

Table 1-1: Immediate Notifications

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
Notifications to be made for ALL LEVELS of spill *(For spills from a vessel the following notifications must be undertaken by a WEL representative).*							
Immediately	Offshore Installation Manager (OIM) or Vessel Master	Woodside Communication Centre (WCC)	Duty Manager	[redacted] or [redacted] or Sat phone: [redacted]	Verbally notify WCC of event and estimated volume and hydrocarbon type.	Verbal	
Within 2 hours	OIM or Woodside Site Rep (WSR)	National Offshore Petroleum Safety Environmental Management Authority (NOPSEMA[1])	Incident notification office	1300 674 472	Verbally notify NOPSEMA for spills >80L. Record notification using Initial Verbal Notification Form or equivalent and send to NOPSEMA as soon as practicable (cc to NOPTA and DMIRS).	APPENDIX B – Forms 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 NOPTA: resources@nopta.gov.au DMIRS: petreps@dmirs.wa.gov.au	APPENDIX B – Forms FORM 2	
As soon as practicable	OIM or WSR	Woodside	Hydrocarbon Spill Preparedness (HSP) Manager	[redacted]	Verbally notify HSP Manager of event and estimated volume and hydrocarbon type.	Verbal	

[1] Notification to NOPSEMA must be from a Woodside Representative.

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
As soon as practicable	CICC DM or Delegate	Woodside	Duty Environment	As per roster	Verbally notify Duty Environment of event and seek advice on relevant performance standards from EP.	Verbal	
As soon as practicable	CICC DM or Delegate	Department of Agriculture, Water and the Environment (Director of National Parks)	Marine Park Compliance Duty Officer	[redacted]	The Marine Park Compliance Duty Officer is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken. The notification should include: • titleholder details • time and location of the incident • proposed response arrangements and locations as per the OPEP • contact details for the response coordinator.	Verbal	
Additional notifications to be made ONLY if spill is from a vessel							
Without delay as per protection of the Sea Act, part II, section 11(1)	Vessel Master	Australian Maritime Safety Authority (AMSA)	Response Coordination Centre (RCC)	1800 641 792 or [redacted]	Verbally notify AMSA RCC of the hydrocarbon spill. Follow up with a written Marine Pollution Report (POLREP) as soon as practicable following verbal notification.	APPENDIX B – Forms FORM 3	
Additional Level 2/3 Notifications							
As soon as practicable	CICC DM or Delegate	Australian Marine Oil Spill Centre (AMOSC)	AMOSC Duty Manager	[redacted] amosc@amosc.com.au	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 – Forms FORM 4	
As soon as practicable	CICC DM or Delegate	Oil Spill Response Limited (OSRL)	OSRL Duty Manager	Singapore Office [redacted]	Contact OSRL Duty Manager and request assistance from technical advisor in Perth. Send the notification form to OSRL as soon as practicable.	APPENDIX B – Forms Notification: FORM 6a	

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					For mobilisation of resources, send the Mobilisation Form to OSRL as soon as practicable.	Mobilisation: 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)	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 if required. N.B. This would be additional to Woodside's own equipment stockpiles and those of its primary response contractors. Follow up with a written POLREP 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.	APPENDIX B – Forms FORM 5	
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] or [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 Strategies

For the relevant hydrocarbon type, undertake quick revalidation of the recommended strategies 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 strategies and pre-identified tactics have been identified from the pre-operational NEBA presented in the Okha FPSO Facility 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	Cossack Light 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	Tracking buoy deployed within 2 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 – Drifter 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 Woodside Maps (Emergency Response) and weathering fate analysis using ADIOS (refer to the hydrocarbon information in APPENDIX A – credible spill scenarios and Hydrocarbon Information	Intelligence or Environment	Initial modelling within 6 hours using the Rapid Assessment Tool. Detailed modelling within 4 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 – Forms, 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 – Forms, FORM 8.	Logistics – Aviation	2 trained aerial observers deployed by day 1. 1 aircraft available for 2 sorties per day from day 1. Observer to compile report during flight and made available to the IMT within 2 hours of each sortie landing		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02) of The Operational Monitoring Operational Plan. *Planning to download immediately and follow steps*

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Cossack Light Crude					
	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	Service provider will confirm availability of an initial acquisition within 2 hours. First image received within 24 hours of acceptance of the proposed acquisition plan.		
	Yes	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	Service provider 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.		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	Within 2 days, deployment of 2 specialists from resource pool in establishing the status of sensitive receptors.		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	Within 2 days deployment of 1 specialist(s) in Shoreline Clean-up Assessment Technique (SCAT) for each of the Response Protection Areas (RPAs) with predicted impacts.		Shoreline Assessment (OM05) of The Operational Monitoring Operational Plan,

3. LEVEL 2/3 RESPONSE

3.1 Mobilisation of Response Strategies

For the relevant hydrocarbon type, undertake quick revalidation of the recommended strategies 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 Okha FPSO Facility 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	Cossack Light 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	Tracking buoy deployed within 2 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 – Drifter Buoy Deployment Instructions.
	Yes	Yes	Undertake initial modelling using the Rapid assessment oil spill tool Woodside Maps (Emergency Response) and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in APPENDIX A – credible spill scenarios and Hydrocarbon Information).	Intelligence or Environment	Initial modelling within 6 hours using the Rapid Assessment Tool. Detailed modelling within 4 hours of APASA receiving information from Woodside.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01) of The Operational Monitoring Operational Plan.
	Yes	Yes	Send Oil Spill Trajectory Modelling (OSTM) form (APPENDIX B – Forms, FORM 7) to RPS APASA.	Intelligence			
	Yes	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to complete log in APPENDIX B – Forms, FORM 8.	Logistics – Aviation	2 trained aerial observers' available by day 1. 1 aircraft available for 2 sorties per day from day 1. Observer to compile report during flight and made available to the IMT within 2 hours of landing after each sortie.		

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Cossack Light Crude					
					Unmanned Aerial Vehicles/ Systems (UAV/UASs) to support tactics and as contingency if required.		
	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 +4777661300).	Intelligence	Service provider will confirm availability of an initial acquisition within 2 hours. First image received with 24 hours of Woodside confirming its acceptance of the proposed acquisition plan. Service provider to submit report to Woodside per image with polygon of any possible or identified slick(s) with metadata. Data received to be uploaded into Woodside Common Operating Picture (COP daily)		
	Yes	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	Service provider to 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. Daily fluorometry reports will be provided to IMT. Use of Autonomous Underwater Vehicles (AUVs) for hydrocarbon presence and detection may be used as a contingency.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03) 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	Cossack Light Crude					
	Yes	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	Within 2 days, in agreement with WA DoT, deployment of 2 specialists		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	Within 2 days, in agreement with WA DoT, deployment of 1 specialist in SCAT for each of the Response Protection Areas (RPA) with predicted impacts.		Shoreline Assessment (OM05) of The Operational Monitoring Operational Plan.
Surface Dispersant	No	Yes	Mobilise Karratha and Exmouth stockpiles. 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	1 aircraft with minimum payload of 1,850 litre mobilised to site within 4 hours of activation. 1 additional aircraft mobilised to site within another 20 hours of activation. 4 additional aircraft mobilised to site within 48 hours of activation. 1 high capacity aircraft with minimum payload of 10 m^3 available to spray on day 2. 2 offtake support vessels from integrated fleet will undertake dispersant trials within 48 hours of the release as per first strike plan. Up to 4 vessels spraying per day by day 5. Access to 5,000 m^3 of dispersant on activation of GDS membership within 24-48 hours.		Surface Dispersants Operational Plan
Mechanical Dispersion	No	No	This strategy is not recommended.				

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Cossack Light Crude					
			It is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.				
Containment and Recovery	No	Yes	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 (NOFI Buster Series, Desmi speed Sweep etc should be prioritised to increase encounter rates)	Logistics and Planning	2 vessel-based containment and recovery operations would be deployed by day 2. 4 additional vessel-based containment and recovery operations using 3rd party provider resources would be deployed by day 10. Deployment of 2 containment and recovery teams would be available by day 2, and 4 containment and recovery teams available by day 5. Each operation will have internal or added 100 m^3 of liquid waste storage onboard.		Containment and Recovery Operational Plan
In Situ Burning	No	No	This strategy 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 and Deflection	No	Yes	Woodside will mobilise and begin the shoreline protection and deflection response to reduce the volume of oil at shorelines by deploying protection and deflection equipment at selected RPA shorelines 5 days prior to impact (first	Operations and Planning	In agreement with WA DoT, activate relevant Tactical Response Plans (TRPs) within 24 hours of the release. In agreement with WA DoT, mobilise teams (2 supervisors plus 10 additional personnel) to RPAs within		Protection and Deflection Operational Plan *Logistics to download immediately and follow steps* Tactical Response Plans available from:

Response Strategies	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Cossack Light Crude					
			impact predicted to be in 7 days at Barrow Island). Equipment from Woodside, AMOSC and AMSA Western Australian Stockpiles mobilised. Consideration of mobilisation of interstate/international shoreline protection equipment (i.e. OSRL).		48 hours of operational monitoring predicting impacts. In agreement with WA DoT, equipment mobilised from closest stockpile within 48 hours. Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 48 hours.		*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 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 Barrow and Lowendal Islands TRP Pilbara Islands - Southern Island Group TRP Shark Bay Areas 1-11 TRPs Exmouth Gulf TRP Muiron 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	Cossack Light Crude					
			Mobilise security provider as per security support plan.				Land Based Security Support Plan
Shoreline Clean Up	No	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	In agreement with WA DoT, deployment of 1 shoreline clean-up team to each contaminated RPA within 48 hours of operational monitoring predicting impacts. Relevant Tactical Response Plans (TRPs) available for shoreline contacted by accumulation >100 g/m^2 within 48 hours of operational monitoring predicting impacts. Access to at least 675 m^3 of solid and liquid waste storage available within 5 days 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. Consider whether additional equipment is required from local suppliers.	Logistics and Planning	Facilities for oiled wildlife rehabilitation are operational 24/7		Oiled Wildlife Response Operational Plan
Scientific Monitoring (Type II)	Yes	Yes	Notify Woodside science team of spill event.	Environment			Oil Spill Scientific Monitoring Programme – 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	Cossack Light Crude					
For well integrity event the following strategies apply:							
Well Intervention – SFRT	No	Yes	Debris clearance equipment to be mobilised prior to deployment of SSDI equipment.	Operations, Logistics and Drilling & Completions (source control)	Remotely Operated Vehicle (ROV) on Mobile Offshore Drilling Unit (MODU) ready for deployment within 48 hours, subject to risk assessment and approvals, to undertake inspection and/or well intervention. Intervention vessel with minimum requirement of a working class ROV and operator – mobilised to site for deployment within 11 days. ROV equipment deployed within 7 days.		Source Control and Well Intervention Operational Plan
Subsea Dispersant	No	Yes	Consider the need to mobilise suitable support vessel and reeled injection unit.	Operations (Source Control Unit)	Equipment to be mobilised within 24 hours if required. SSDI operations to be deployed to the field within 12 days 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 place, the existing barriers would be remain active.				
Relief Well	No	Yes	As per Okha FPSO Facility Operations – Blowout Contingency Plan.	Operations, Logistics and Drilling & Completions (source control)	ROV on MODU ready for deployment within 48 hours, subject to risk assessment and approvals, to undertake inspection and/or well intervention. Identify source control vessel availability within 24 hours. Vessel		Source Control and Well Intervention 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	Cossack Light Crude					
					mobilised to site for deployment within 12 days. Mobile Offshore Drilling Unit MODU mobilised to location within 21 days		

4. PRIORITY RECEPTORS

Note: DoT are the Control Agency to respond to all sites in a Level 2/3 spill into State waters/ shorelines. Woodside develops plans for incidents in State Waters/ shorelines and maintains capability in terms of resources for responding to incidents in state waters.

Action: Provide DoT with all relevant Tactical Response Plans for any locations predicted to be contacted.

Based on hydrocarbon spill risk modelling results there are no sensitive receptors identified as Response Protection Area (RPA), as they do not have the potential to be contacted by any hydrocarbon at or above threshold levels within 48 hours of a spill.

Oil Spill Trajectory Modelling (as per OM02) specific to the spill event will be required to determine the regional sensitive receptors to be contacted beyond 48 hours of a spill.

Preliminary hydrocarbon spill modelling results indicate the sensitive receptors listed in Table 4-1 have the potential to be contacted by hydrocarbons above threshold concentrations beyond 48 hours of a spill:

Table 4-1: Receptors for Priority Protection

Receptor	Distance and Direction from Operational Area (km)	Minimum time to shoreline contact (above $100 g/m^2$) in days	Maximum shoreline accumulation (above $100 g/m^2$) in m^3	Minimum time to shoreline contact (above $100 g/m^2$) in days	Maximum shoreline accumulation (above $100 g/m^2$) in m^3	Tactical Response Plans/ Oiled Wildlife Response Plans (also available within the Data Directory)
		Scenario 1 (MEE-01)		Scenario 5 (MEE-05)		
Ningaloo Coast North and World Heritage Area	259 km south-west	75 days (20 m^3)	30 m^3 (day 77)	40 days (0.3 m^3)	1.1 m^3 (day 44)	• Mangrove Bay TRP • Turquoise Bay TRP • Yardie Creek TRP • Exmouth OWRP
Montebello Islands and State Marine Park	105 km south-west[2]	No contact	No contact	11 days (71 m^3)	113 m^3 (day 14)	• 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 • Dampier Region OWRP

[2] *Approximate distance to nearest landfall*

Barrow Island	114 km south-west	No contact	No contact	12 days (4 m^3)	63 m^3 (day 15)	• Barrow and Lowendal Islands TRP • Dampier Region OWRP
Lowendal Islands	103 km south-west[4]	No contact	No contact	12 days (1 m^3)	3 m^3 (day 16)	• Barrow and Lowendal Islands TRP Dampier Region OWRP
Pilbara Islands – Southern Islands Group	233 km south-west	76 days (1.4 m^3)	66 m^3 (day 84)	19 days (0.7 m^3)	36 m^3 (day 40)	• Pilbara Islands - Southern Island Group TRP • Dampier Region OWRP
Shark Bay World Heritage Area	610 km south-west	99 days (0.2 m^3)	0.2 m^3 (99 days)	No contact	No contact	• Shark Bay Areas 1-11 TRPs • Shark Bay OWRP
Exmouth Gulf West	272 km south-west	83 days (0.08 m^3)	0.2 m^3 (87 days)	No contact	No contact	• Exmouth Gulf TRP • Exmouth OWRP
Muiron Islands Marine Management Area and World Heritage Area	259 km south-west	75 days (0.3 m^3)	41 m^3 (99 days)	40 days (3 m^3)	4 m^3 (day 45)	• Muiron Islands TRP • Exmouth OWRP

Tactical Response Plans for a number of these locations can be accessed via the Oil Spill Portal – Tactical Response Plans and are also listed in Table 3-1 and Table 4-1 of this document.

Please note that impact thresholds used to determine the Environment That May Be Affected (EMBA) identified in the Environment Plan are lower than response thresholds (Table 4-2).

Table 4-2 Response Thresholds

Surface Hydrocarbon (g/m^2)	Description
>10[3]	Predicted minimum threshold for commencing operational monitoring
50	Predicted minimum floating oil threshold for effective containment and recovery and surface dispersant application [4]
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

[3] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

[4] At 50g/m^2 containment and recovery and surface dispersant application operations are not expected to be particularly effective. This threshold represents a conservative approach to planning response capability and displaying the spread of surface oil.

Figure 4-1 illustrates the location of regional sensitive receptors in relation to the Okha FPSO Facility operational area and identifies priority protection areas. Figure 4-2 and Figure 4-3 illustrate the deterministic modelling results for scenario 1 (MEE-01) and scenario 5 (MEE-05). A total of 100 replicate simulations were completed for MEE-01 over an annual period 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). For MEE-05 a total of 200 replicate simulations were run over an annual period (50 simulations per quarter).

Consideration should be given to other stakeholders (including mariners) in the vicinity of the spill location. Table 4-3 indicates the assets within the vicinity of the Okha FPSO Facility operational area.

Table 4-3: Assets in the vicinity of the Okha FPSO Facility operational area.

Asset	Distance and Direction from Okha FPSO Facility	Operator
Angel	20 km east	Woodside
Goodwyn Alpha	54 km south-west	Woodside
NRC	32 km west	Woodside
Reindeer	51 km south	Santos
Stag	81 km south	Santos
Pluto	122 km south-west	Woodside

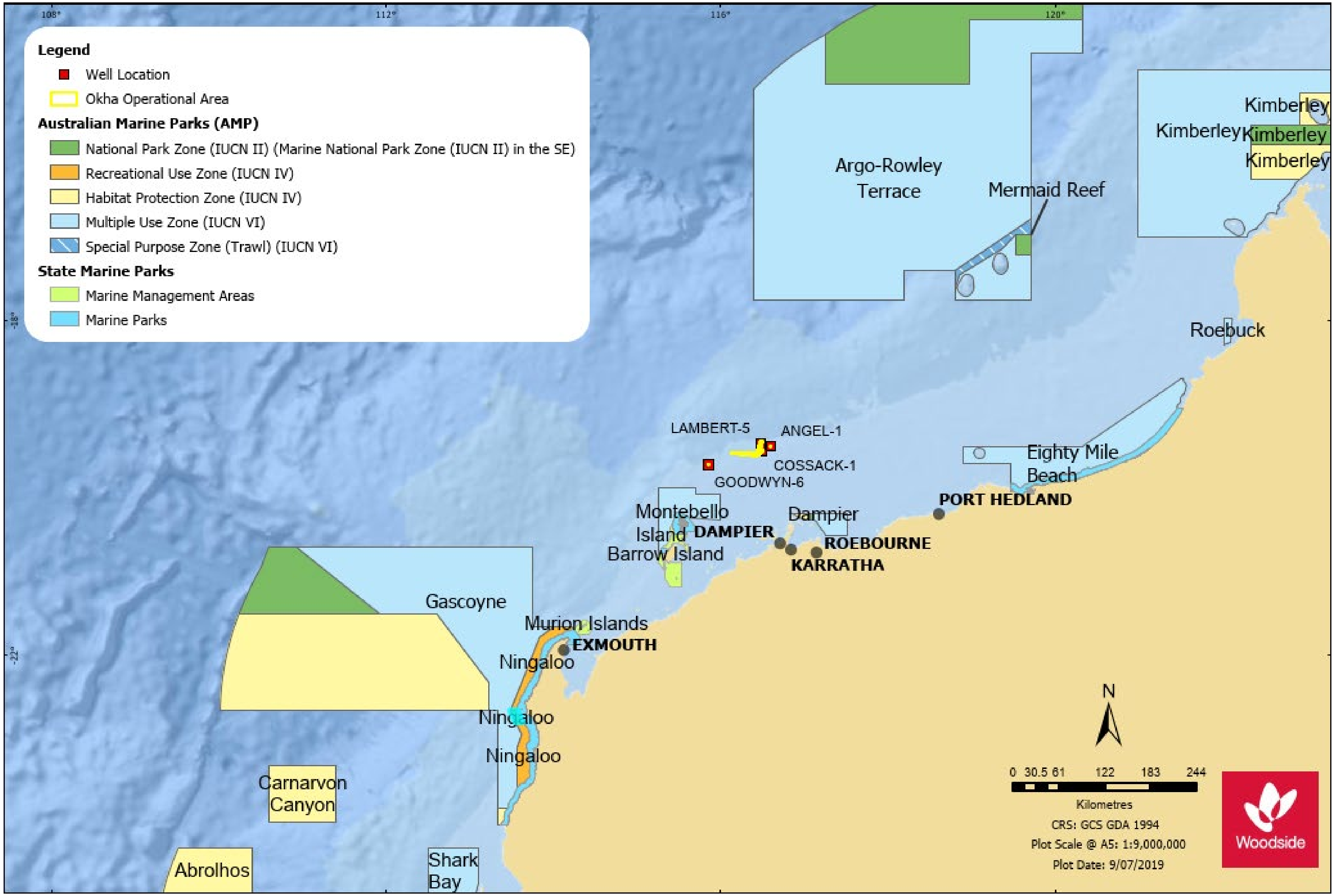


Figure 4-1: Commonwealth and State Marine Protected Areas in relation to Okha FPSO Facility, Lat: 19° 26' 58.47" S Lon: 116° 29' 16.23" E

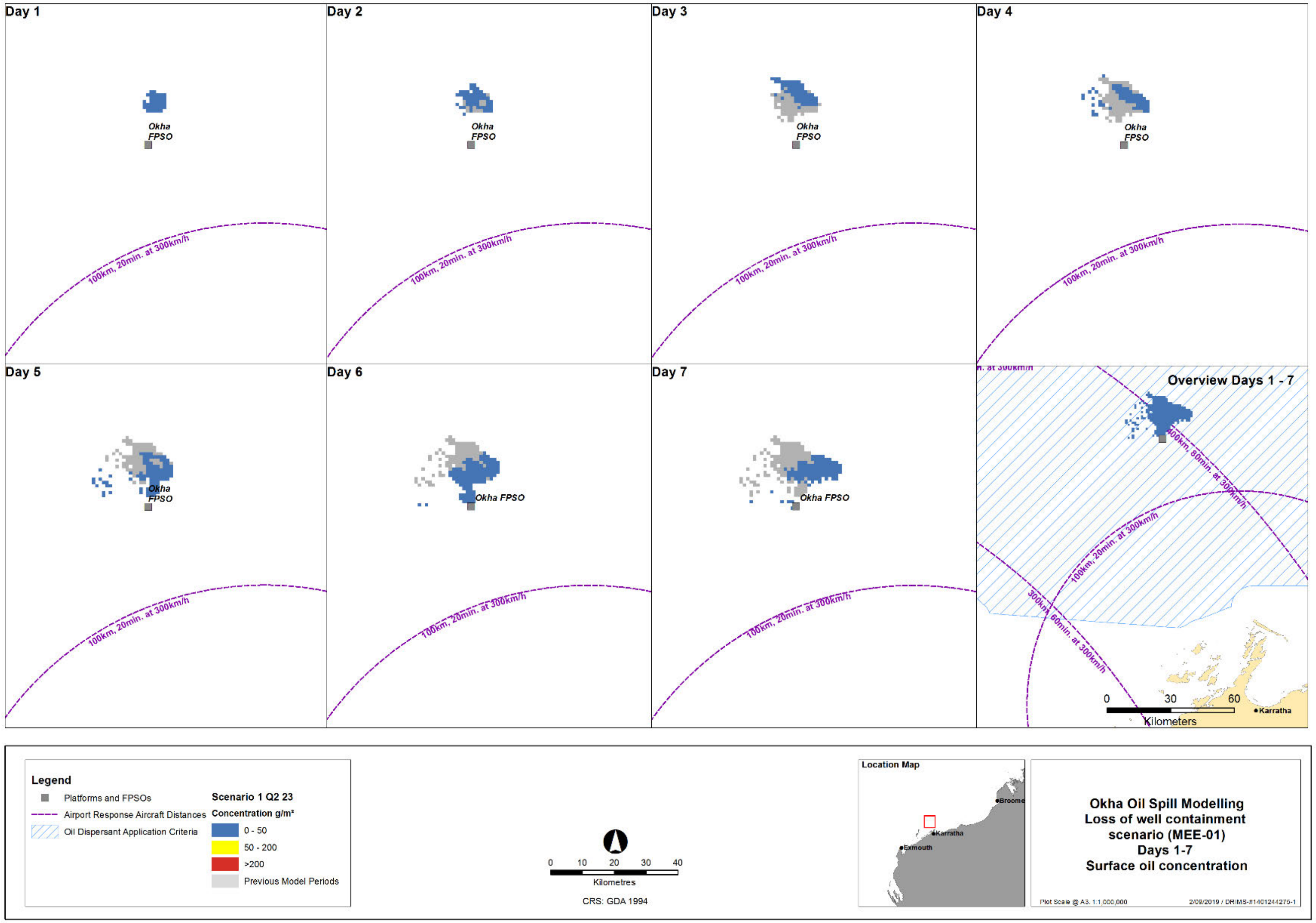


Figure 4-2: Okha FPSO Facility loss of well containment (MEE-01) – Day 1-7 – Surface oil concentration

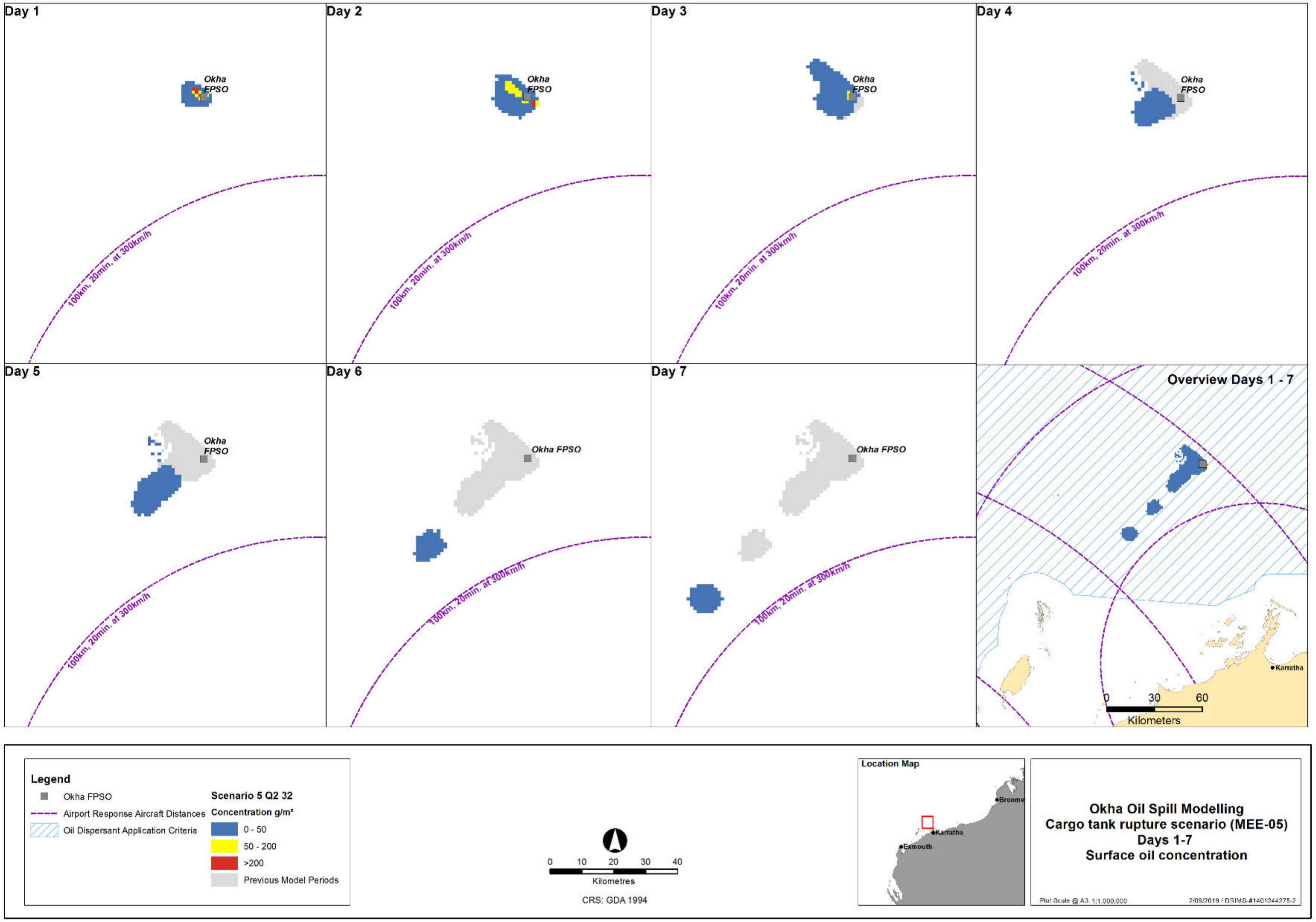


Figure 4-3: Okha FPSO Facility loss of cargo tank containment (MEE-05) – Day 1-7 – Surface oil concentration

5. DISPERSANT APPLICATION

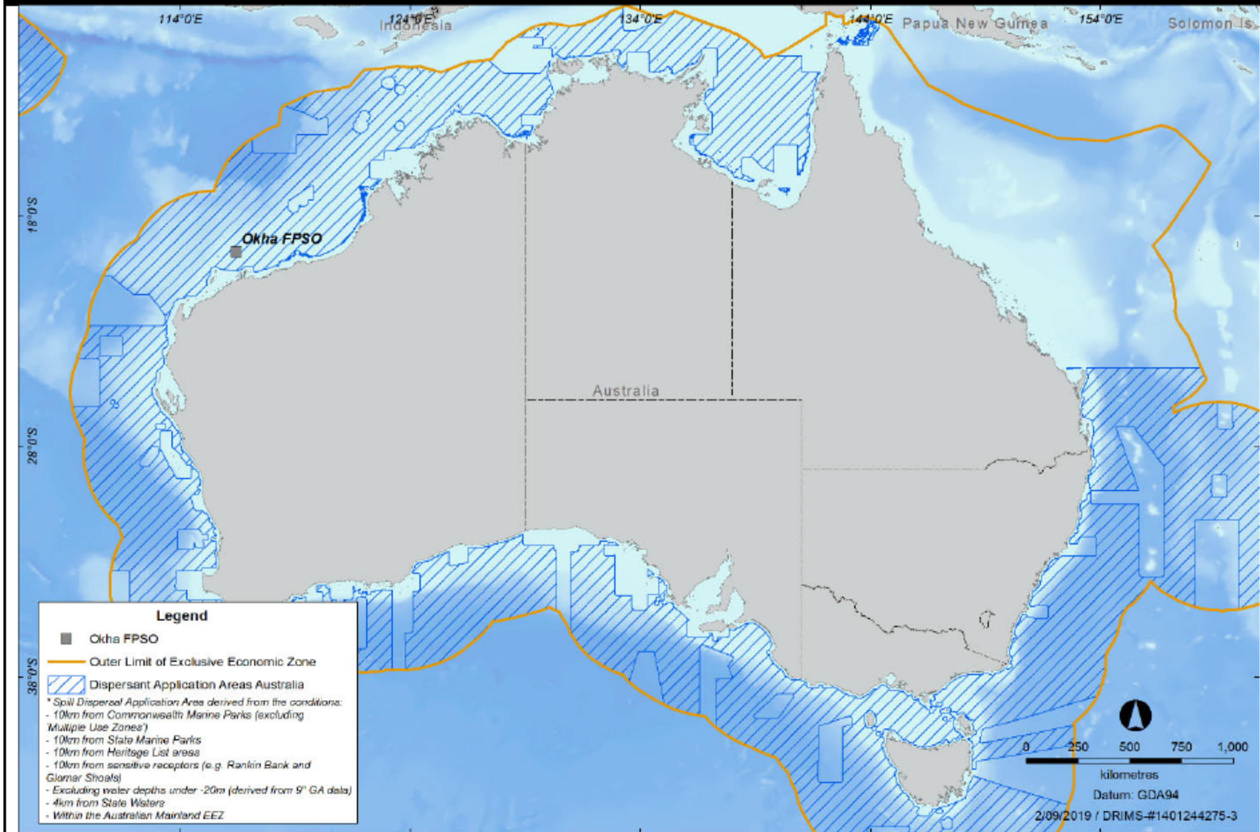
INSTRUCTIONS

DISPERSANTS ARE PRE-APPROVED FOR USE IN THE BLUE STRIPED ZONE ONLY. OSCA APPROVED OR TRANSISTIONAL DISPERSANTS ARE PRE-APPROVED FOR USE.

The shape file for the approved dispersant zone is saved in Woodside's Corporate Geodatabase by GTO.

The **SURFACE DISPERSANT OPERATIONAL PLAN** should be used to mobilise dispersant operations immediately – Surface Dispersants Operational Plan

PRE-APPROVED DISPERSANT ZONE



DISPERSANT VOLUMES

Current dispersant volumes available should be checked in the following document:
Oil Spill Preparedness – Dispersant Stockpiles Datasheet

APPENDIX A – CREDIBLE SPILL SCENARIOS AND HYDROCARBON INFORMATION

For more detailed hydrocarbon information see the
Hydrocarbon Data Directory

Credible Spill Scenarios

Scenario	Product	Maximum Volumes	Suggested ADIOS2 Analogue*
MEE-01 Uncontrolled subsea hydrocarbon release caused by loss of well containment after a loss of well control	Cossack Light Crude	185,915 m^3	Cossack Light Crude API 48.1
MEE-02 An instantaneous subsea release due to a flowline or riser rupture at the midpoint of the WC Production Line flowline	Cossack Light Crude	773 m^3	Cossack Light Crude API 48.1
MEE-03 Instantaneous surface hydrocarbon release due to a support vessel tank rupture	Marine diesel	105 m^3	Diesel Fuel Oil (Southern USA 1) API of 37.2
MEE-04 Instantaneous surface release due to an offtake system failure or incident	Cossack Light Crude	724 m^3	Cossack Light Crude API 48.1
MEE-05 Uncontrolled hydrocarbon release representing a loss of containment after a vessel cargo tank rupture	Cossack Light Crude	30,302 m^3	Cossack Light Crude API 48.1

Cossack Light Crude

Cossack Light Crude (API 48.1) contains a moderate proportion (15.3% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a dynamic viscosity of 1.40 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

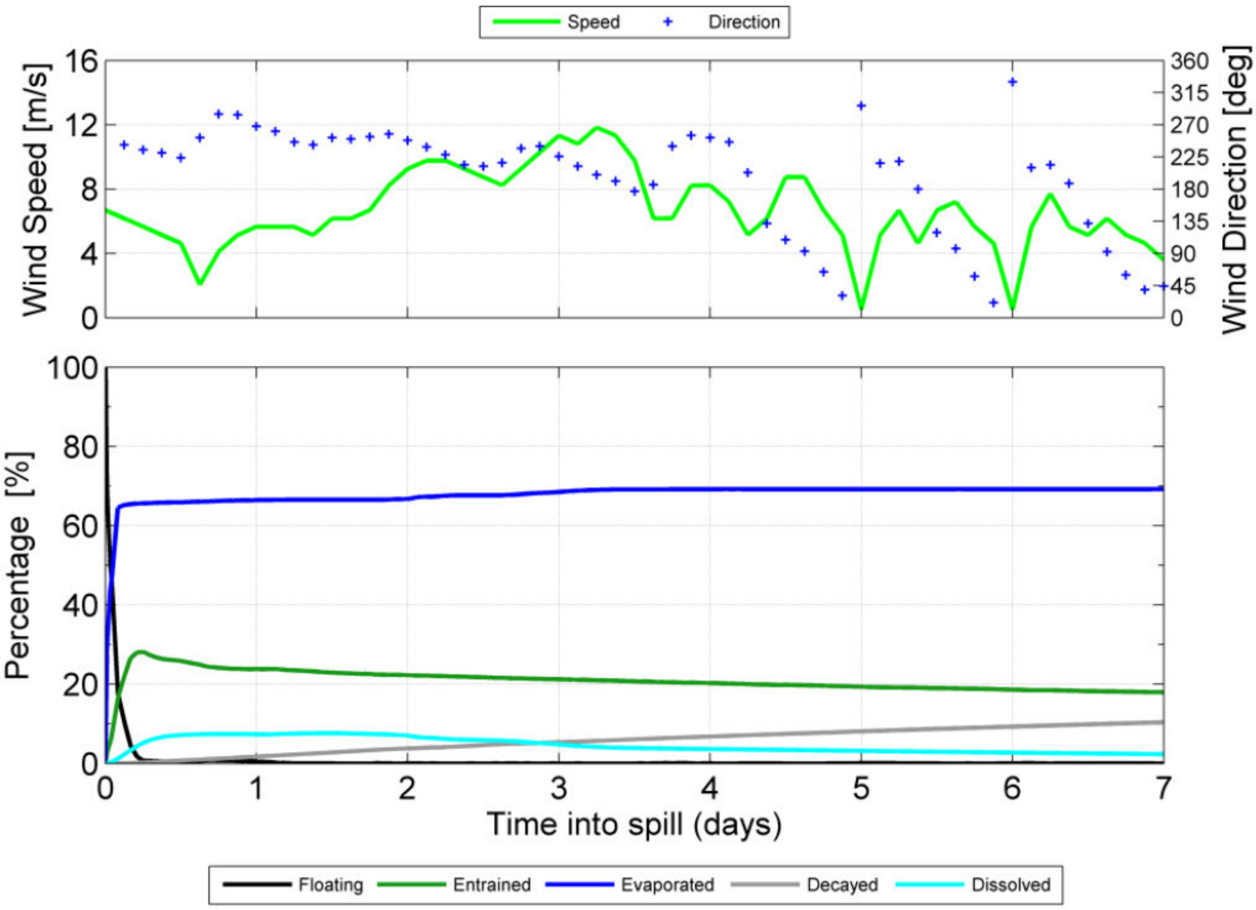


Figure A-0-1: Proportional mass balance plot representing the weathering of Cossack Light Crude spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

The increased level of entrainment in the variable-wind case will result in higher levels of biological and photochemical degradation, with an approximate rate of 1.5% per day and an accumulated total of 10% after 7 days in comparison to a rate of ~0.5% per day and an accumulated total of 3.6% after 7 days in the constant-wind case. The slow degradation of the weathered crude will extend the area of potential effect, requiring the break-up and dispersion of the slicks to reduce concentrations below the thresholds considered in this study.

The results of the OILMAP simulation predict that the discharge will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of around 3 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 16 m.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of response operations at or near the blowout site. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Marine diesel

Marine diesel 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%.

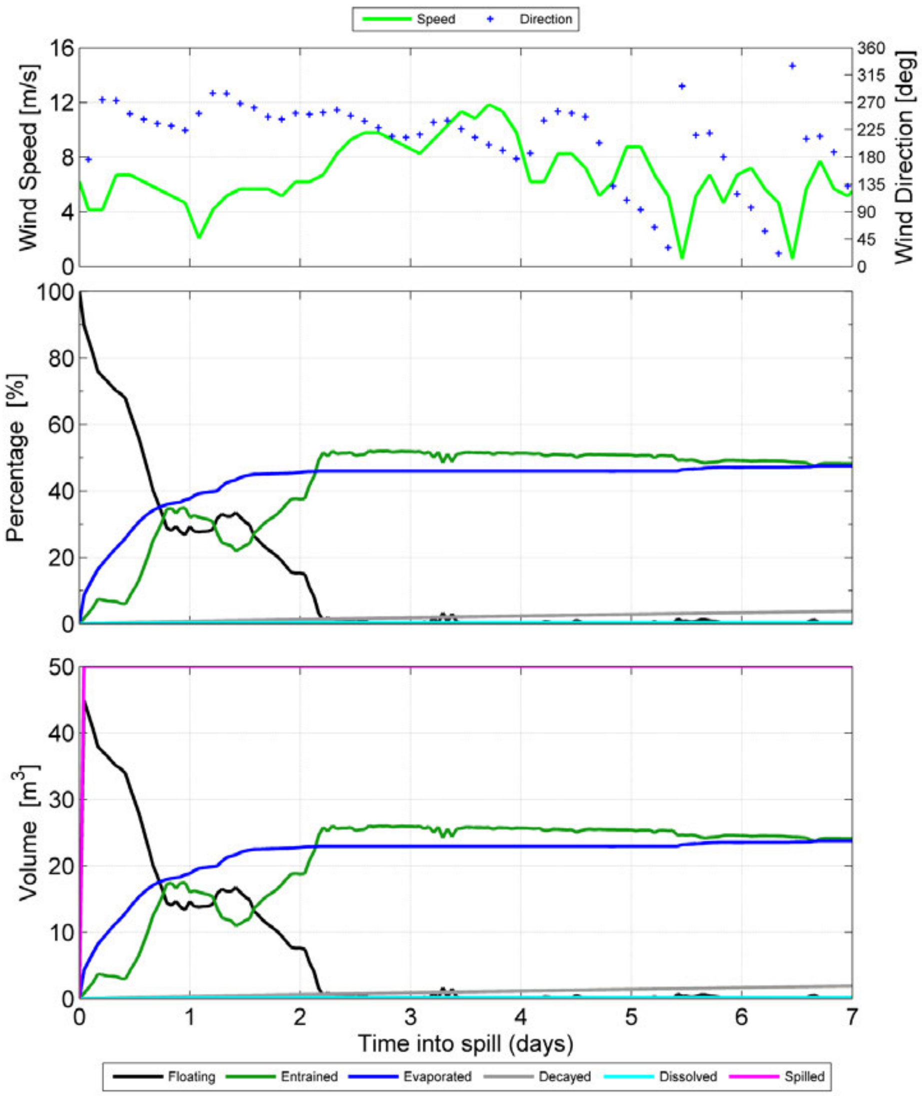


Figure A-0-2: Proportional mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable winds (top panel) at 27 C water temperature

APPENDIX B – FORMS

Form No.	Form Name	Link (if available)
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	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

Woodside

(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

[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 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 when printing]
Link

FORM 8

[insert Aerial Surveillance Observer Log when printing]
Link

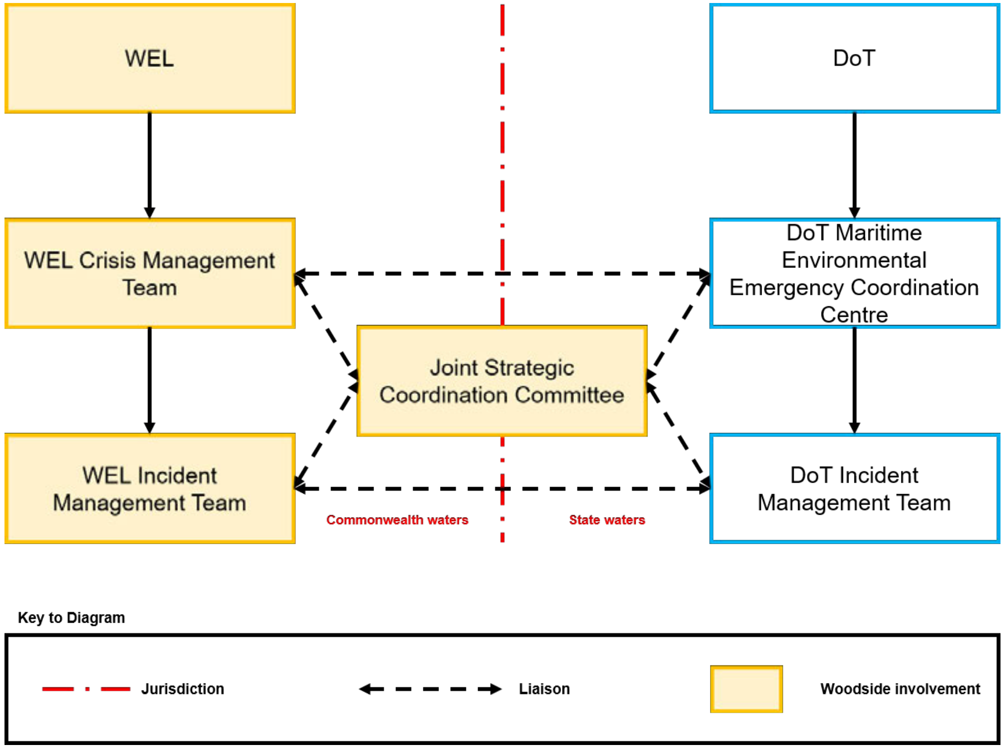
APPENDIX C – 7 QUESTIONS OF SPILL ASSESSMENT

WHAT IS IT? Oil Type/name Oil properties Specific gravity / viscosity / pour point / asphaltenes / 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 – DRIFTER BUOY DEPLOYMENT INSTRUCTIONS

(Insert instructions when printing)

APPENDIX E – COORDINATION STRUCTURE FOR A CONCURRENT HYDROCARBON SPILL IN BOTH COMMONWEALTH & STATE WATERS/SHORELINES[5]

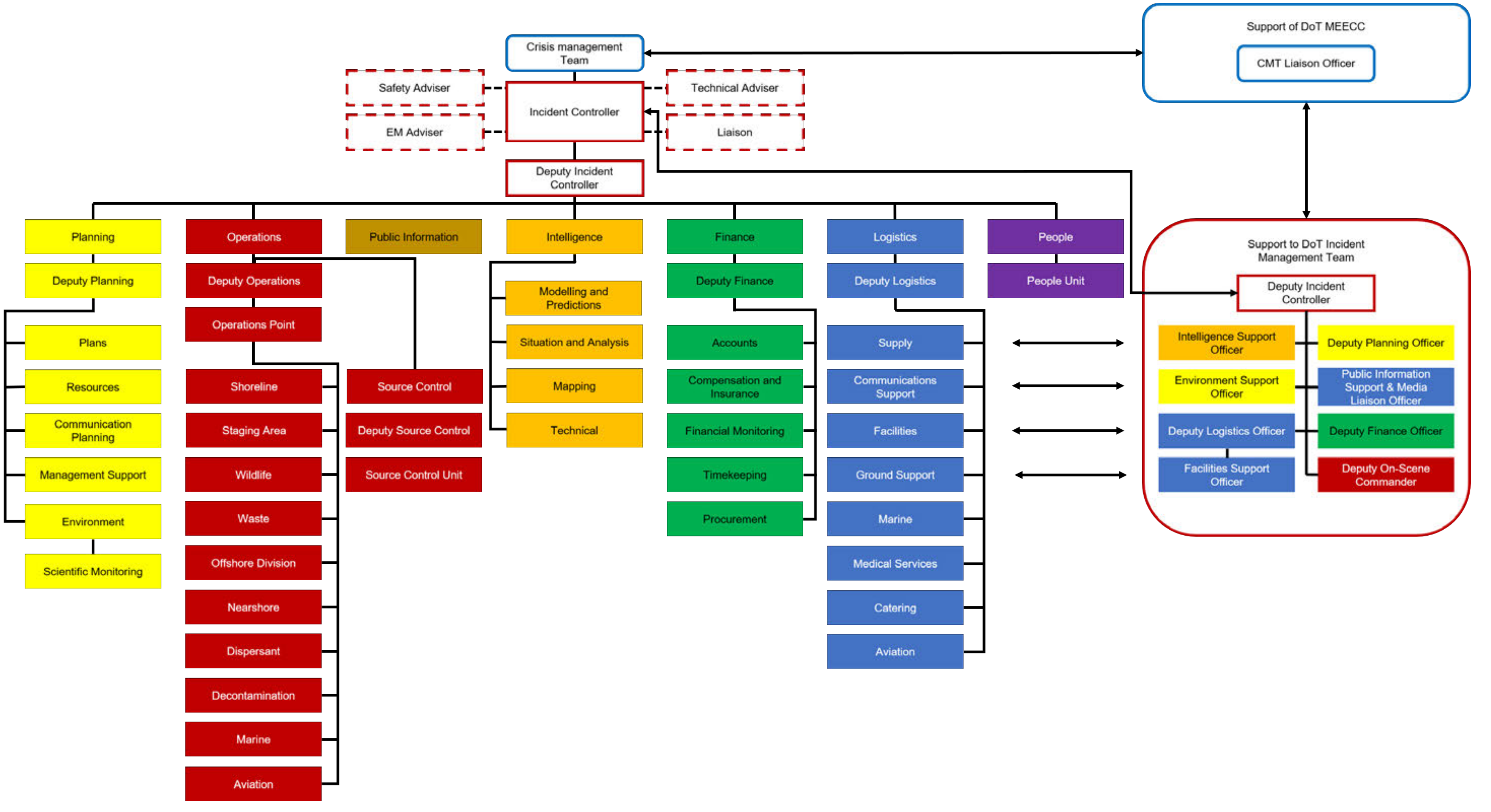


The Control Agency for a hydrocarbon spill in Commonwealth waters/shorelines resulting from an offshore petroleum activity is Woodside (the Petroleum Titleholder). The Control Agency for a hydrocarbon spill in State waters/shorelines resulting from an offshore petroleum activity is DoT. DoT will appoint an Incident Controller and form a separate IMT to only manage the spill within State waters/shorelines.

[5] Adapted from DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements September 2018. Note: For full structure up to Commonwealth Cabinet/Minister refer to Marine Oil Pollution: Response and Consultation Arrangements Section 6.5, Figure 4.

APPENDIX F – WOODSIDE INCIDENT MANAGEMENT STRUCTURE

Woodside Incident Management Structure for Hydrocarbon Spill (including Woodside Liaison Officers Command Structure within WA DoT IMT if required).



APPENDIX G – WOODSIDE LIAISON OFFICER RESOURCES TO WA DOT

Once WA DoT activates a State waters/shorelines IMT, Woodside will make available the following roles to WA DoT.

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
DoT MEECC	CMT Liaison Officer	CMT Duty Managers Roster	• Provide a direct liaison between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT and State Maritime Environment Emergency Coordinator (SMEEC). • Offer advice to SMEEC on matters pertaining to Petroleum Titleholder (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 Planning-Intelligence/ Mapping	Intelligence Support Officer	AMOSC Staff Member or AMOSC Core Group	• 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 Planning- Plans/ Resources	Deputy Planning Officer	AMOSC Core Group/CICC Planning Coordinator Reserve List and Planning Group 3	• Facilitate the provision of relevant IAP and sub plans from the PT IMT. • 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.	1
DoT IMT Planning- Environment	Environment Support Officer	CMT Environmental FST Duty Managers Roster	• 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

[6] See Combined CICC, KICC, CMT roster and Preparedness Schedule Link / AMOSC Service Contract Link

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
DoT IMT Public Information-Media/ Community Engagement	Public Information Support and Media Liaison Officer	CMT Reputation {Media} FST Duty Manager Roster	• 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	• 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.	1
DoT IMT Logistics-Waste	Facilities Support Officer	CMT Services FST Logistics Team 2 and WEL Waste Contractor Roster	• Facilitate the acquisition of appropriate services and supplies through the PTs existing private contract arrangements related to waste management. • Collects Request Forms from DoT to action via PT IMT.	1
DoT IMT Finance-Accounts/ Financial Monitoring	Deputy Finance Officer	CICC Finance Coordinator Roster	• As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through Woodside's existing OSRL, AMOSC and private contract arrangements. • Facilitate the communications of financial monitoring information to Woodside to allow Woodside to track the overall cost of the response. • Assist the finance office in the tracking of financial commitments thought he response, including the supply contracts commissioned directly and to be charged back to Woodside.	1
DoT FOB Operations Command	Deputy On-Scene Commander	AMOSC Core Group	• Provide a direct liaison between the PT FOB and DoT FOB. • Facilitate effective communications and coordination between the PT FOB Operations Commander and the DoT FOB Operations Commander. • Offer advice to the DoT FOB Operations Commander on matters pertaining to PT incident response policies and procedures. • Assist the Senior Safety Officer deployed in the FOB in the performance of their duties, particularly as they relate to PT employees or contractors. • Offer advice to the Senior Safety Officer deployed in the FOB on matters pertaining to PT safety policies and procedures.	1
			Total Woodside Personnel Initial Requirement to DoT IMT	10

WA DOT LIAISON OFFICER RESOURCES TO WOODSIDE

Once WA DoT activates a State waters/shorelines IMT, WA DoT will make available the following roles to Woodside.

Area	DoT Liaison Role	Personnel Sourced from:	Key Duties	#
WEL CMT	DoT Liaison Officer	DoT	• Provide a direct liaison via CICC HSP Advisor between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT Leader and SMEEC. • Offer advice to CMT Leader on matters pertaining to DoT and wider government emergency management policies and procedures. • 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 PT IC on matters pertaining to DoT and wider government incident response policies and procedures. • Facilitate requests for specific tasks from PT IMT related to Aviation and Waste Management.	1
WEL Reputation FST (Media Room)	DoT Media Liaison Officer	DoT	• Provide a direct liaison via Reputation FST Media Team between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. • Assist in the release of joint information and warnings through the DoT Information and Warnings team. • Offer advice to the PT Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures.	1
Total DoT Personnel Initial Requirement to Woodside				2