WA-404-P Drilling Environment Plan Summary

Exploration Division

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Revision 0

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1. INTRODUCTION

Woodside Energy Ltd (Woodside), as Titleholder under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (referred to as the Environment Regulations), proposes to undertake drilling of up to six wells (up to 3 exploration and 3 appraisal wells), including the Ferrand exploration well (Ferrand-1), as well as re-entry into the previously drilled and suspended Noblige-1 for well plug and abandonment. Detailed planning and scheduling of the Ferrand-1 well is currently being undertaken, with the remaining exploration/appraisal wells to be planned pending outcomes of the Ferrand-1 well. The Environment Plan is being written to cover other future drilling in the permit area. This is to allow subsequent exploration/appraisal wells pending the outcome of Ferrand-1 and other commitments.

All drilling activities will take place within Permit Area WA-404-P, hereafter, referred to as the Petroleum Activities Program. The wells are being drilled to explore for potentially commercial hydrocarbon resources and as a commitment under Exploration Permit WA-404-P (the Permit Area) requirements, issued under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act).

This Environment Plan (EP) Summary has been prepared as part of the requirements of Regulations 11(3) and 11(4) of the Environment Regulations, as administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). This document summarises the WA-404-P Drilling Environment Plan (the EP) accepted by NOPSEMA under Regulation 10A of the Environment Regulations.

1.1 Defining the Activity

The Petroleum Activities Program to be undertaken in the Permit Area comprises of exploration and appraisal drilling, and re-entry and plug/abandon activities associated with the Noblige-1 Well. These activities are defined as petroleum activities within Regulation 4 of the Environment Regulations and as such, an EP is required.

2. LOCATION OF THE ACTIVITY

The proposed Petroleum Activities Program is located in Permit Area WA-404-P, in Commonwealth waters on the continental slope approximately 257 km north-west of Dampier (**Figure 2-1**). The closest landfall to the Permit Area are the Montebello Islands, which are approximately 136 km south south-east at the closest point and water depths within the Permit Area range between 1100 to 1600 m. The Permit Area comprises an area of 1388 km^2. Approximate location details for the Petroleum Activities Program are provided in **Table 2-1**.

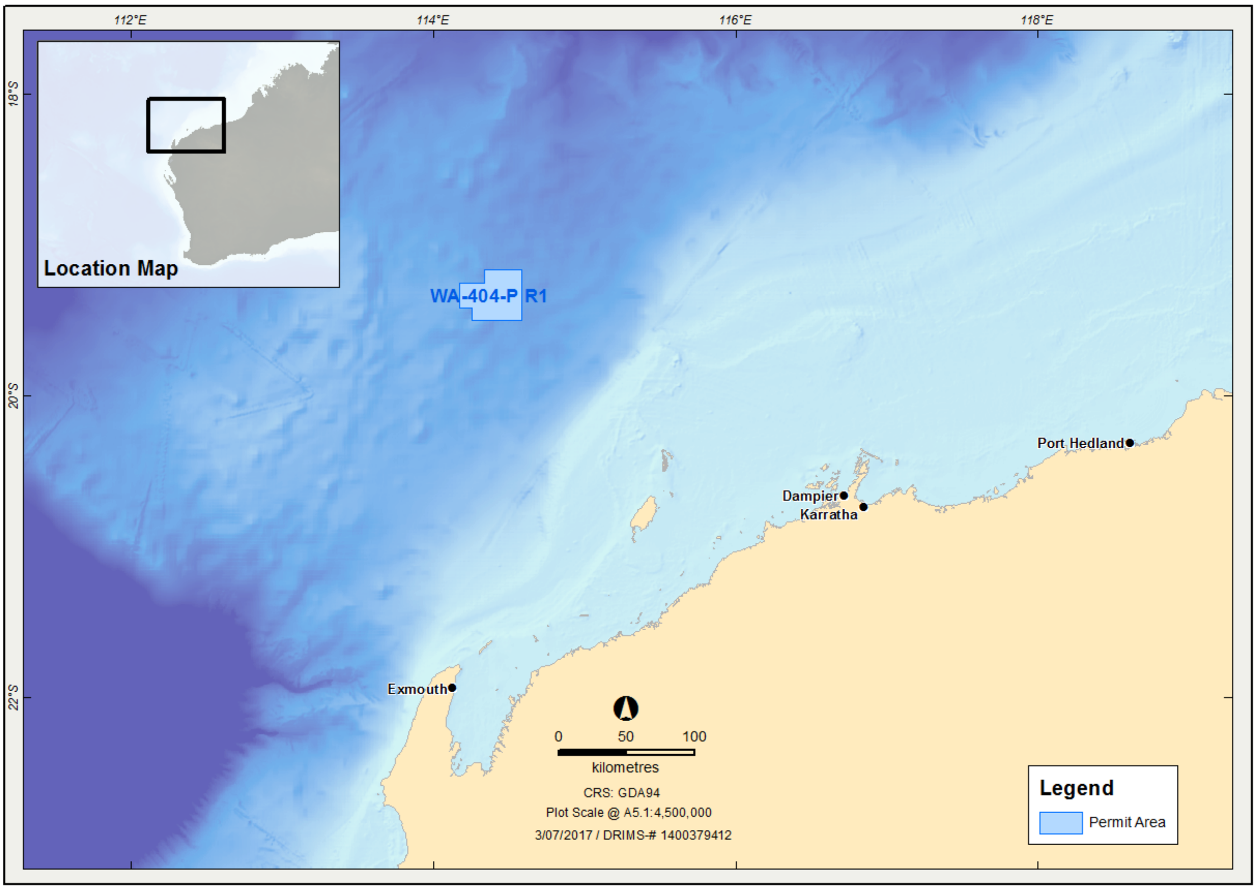

Figure 2-1: Location of the Petroleum Activities Program

Table 2-1: Approximate locations details for the Petroleum Activities Program

Activity	Water Depth (Approx. m LAT)	Latitude	Longitude	Petroleum Licence
Ferrand-1 well	1494	19° 15' 40.415 S	114° 29' 59.935 E	WA-404-P
Exploration wells (2&3)	1100 – 1600	To be determined		WA-404-P
Appraisal wells (1-3)	1100 – 1600	To be determined		WA-404-P
Noblige-1 re-entry plug and abandon	1313	19° 23' 55.061 S	114° 19' 58.698 E	WA-404-P

The spatial boundary of the Petroleum Activities Program has been described and assessed using two "areas", the Permit Area and the Operational Area (discussed below).

The Permit Area defines the spatial boundary within which the Petroleum Activities Program will take place. As the locations of five of the six exploration and appraisal wells within the Permit Area are unconfirmed at the time of EP submission to NOPSEMA, a conservative approach in assessing risks has been employed for the EP. This approach considered the existing environment of the entire Permit Area (along with the environment potentially impacted by the credible hydrocarbon spill scenarios) to provide context for the risk assessment. This approach facilitates the assessment of environmental risks and impacts for all potential well locations to allow for the inherent uncertainty for well locations that are yet to be determined.

An Operational Area encompasses a radius of 4000 m from the well centre, for each of the six proposed exploration/appraisal wells and the re-entry of the Noblige-1 well to be plugged and abandoned. As a result, there will be up to seven Operational Areas for the Petroleum Activities Program.

The 4000 m Operational Area allows for mobile offshore drilling unit (MODU) mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities[1]. The Operational Area for drilling activities includes a 500 m petroleum safety zone around the MODU to manage vessel movements. The 500 m petroleum safety zone is under the control of the MODU Person in Charge (PIC). A 500 m safety zone will also exist around the installation support vessel (ISV) during conductor anchor node (CAN) installation and will be under the control of the vessel captain.

The total area of the Operational Areas in relation to the Permit Area are described in **Table 2-2**.

Table 2-2: Summary of Permit Area and Operational Areas

Description	Area (km^2/%)
Permit Area	1388 km^2
Each Operational Area	50 km^2
Proportion of Permit Area	4%
Maximum cumulative area of all Operational Areas	350 km^2
Proportion of Permit Area covered by cumulative area of all Operational Areas	25%

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

3. DESCRIPTION OF THE ACTIVITY

3.1 Purpose of the Activity

Woodside proposes to undertake the drilling of up to three exploration wells and up to three appraisal wells within the Permit Area. Detailed planning and scheduling of the Ferrand-1 well is currently being undertaken, with the remaining exploration/appraisal wells to be planned pending outcomes of the Ferrand-1 well, or as required under Permit Area requirements issued under the OPGGS Act.

The Petroleum Activities Program also includes re-entry and plug and abandon activities for the historic Noblige-1 well, which was drilled and suspended by Woodside in 2010. Timing of abandonment activities has not yet been determined and will be subject to rig/vessel availability suitable for the campaign.

3.2 Timing of the Activity

The proposed Petroleum Activities Program is scheduled to commence in Q1 2018 with drilling of the Ferrand-1 well. Following Ferrand-1, there are currently no other exploration/appraisal wells scheduled, however, the Environment Plan is being written to cover other future drilling in the permit area. This is to allow subsequent exploration/appraisal wells pending the outcome of Ferrand-1 and other commitments. Drilling of the Ferrand-1 and other exploration wells is expected to take approximately 90-120 days per well (including mobilisation, demobilisation and contingency) to complete. Similarly, appraisal wells are expected to take approximately 90-120 days, excluding well testing activities. Well testing is expected to take approximately 25 days.

The re-entry plug and abandonment of Noblige-1 is expected to take approximately 30 days.

There are no planned concurrent drilling activities under the EP.

Timing and duration of these activities is subject to change due to project schedule requirements, MODU/vessel availability, unforeseen circumstances and weather.

The EP has assessed the risk of drilling activities throughout the year (all seasons), to provide operational flexibility for requirements and schedule changes, as well as vessel / MODU availability.

3.3 Project Vessels

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

- Semi-submersible moored MODU or dynamically positioned (DP) MODU;
- ISV for activities such as offline conductor installation (if used); and
- Support vessels, required for activities such as to run and set anchors and support the MODU, during operations.

Description and assessment of support vessel environmental impacts and risks, credible spill scenarios and environmental sensitivities for the activities are considered within the scope of the EP. Some support vessels may be required on an ad-hoc basis to support periods of high activity and will be subject to Woodside's standard vessel contracting processes and requirements.

3.3.1 MODU

The Petroleum Activities Program will be drilled by a MODU. This is expected to be a semi-submersible MODU that is moored (e.g. the *Ocean Apex*, *Atwood Osprey* or similar), however, the scope of the EP also covers operations by a DP MODU for operational flexibility. Specifications for the *Ocean Apex* and *Atwood Osprey* are detailed in **Table 3-1**. A MODU with similar specifications to the *Ocean Apex* or *Atwood Osprey* will be contracted for the Petroleum Activities Program.

Specifications for the *Atwood Condor* are also provided as an example of a DP MODU that may be used during the Petroleum Activities Program (**Table 3-1**).

Table 3-1: Current MODU specifications ranges for *Ocean Apex* and *Atwood Osprey*

Component	Specification Range	
	Moored MODU (Ocean Apex / Atwood Osprey)	DP MODU (Atwood Condor)
Rig Type/Design/Class	Semi-submersible MODU	Ultra-deepwater semi-submersible MODU
Accommodation	120-200 personnel (maximum persons on board)	200 personnel
Station Keeping	Minimum eight point mooring system	Dynamically positioned
Bulk Mud and Cement Storage Capacity	283-770 m^3	1000 m^3
Liquid Mud Storage Capacity	576-2500 m^3	2663 m^3
Fuel Oil Storage Capacity	966-1400 m^3	3640 m^3
Drill Water storage capacity	3500 m^3	3482 m^3

Holding Station: Mooring Installation and Anchor Holding Testing

Moored MODUs use a system of chains/ropes and anchors, which may be pre-laid before the MODU arrives at the location, to maintain position when drilling. Installation and proof tensioning of anchors involves some disturbance to the seabed. Anchor handling vessels (AHVs) are used in the deployment and recovery of the mooring system.

As part of mooring preparations, anchor holding testing may be conducted at the well locations. Anchor holding testing would be undertaken if Woodside determines that further assurance is required to ensure a robust mooring design. Anchor holding testing may consist of an AHV or similar vessel dropping an anchor at a potential mooring location. The AHV would then tension the anchor to determine its ability to hold, embed and not drag at location. This may have to be repeated several times at each location. A remotely operated underwater vehicle (ROV) may also be utilised to judge how deep the anchor has embedded and independently verify the seabed condition. Anchor holding testing activities would occur prior to the MODU arriving on location.

Holding Station: Dynamic Positioning (DP MODU)

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

3.3.2 Installation Support Vessel

The Petroleum Activities Program may require an ISV with sufficient capacity to accommodate the CAN for the installation and removal of the conductor. A typical ISV will be a DP vessel (usually

DP2 Class) equipped with primary differential global surface positioning system (DGPS) or acoustic positioning and an independent secondary DGPS system.

For installation, vessels are equipped with a variety of material handling equipment which includes cranes, winches, ROVs and ROV Launch and Recovery Systems (LARS). Lifting operations involve loading and unloading equipment onto the seabed. Cranes are typically equipped with active heave compensation and auto tension modes and have lifting capacities in excess of expected lifting loads to be encountered during operations.

3.3.3 Support Vessels

During the Petroleum Activities Program, the MODU will be supported by other vessels, such as general support vessel(s) and AHVs.

Support vessels are used to transport equipment and materials between the MODU and port (e.g. Dampier or Exmouth). One vessel will be present at the MODU on standby at all times and others will transit out of the Operational Area to port for emergency and non-routine operations approximately two – four trips per week.

Support vessels will not anchor within the Permit Area during the activities due to water depth; instead the vessels will use DP systems.

The support vessels are also available to provide support, should an environmental incident occur (e.g. spills).

3.3.4 Refuelling

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

3.4 Other Support

3.4.1 Remotely Operated Vehicles

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

- CAN installation and retrieval;
- Anchor holding testing;
- Pre-drill seabed and hazard survey;
- Blow-out preventer (BOP) land-out and recovery;
- BOP well control contingency;
- Visual observations at seabed during riserless drilling operation; and
- Post-well seabed survey.

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

The ROV may also be used in the event of an incident for the deployment of the subsea first response toolkit (SFRT).

3.4.2 Helicopters

During the Petroleum Activities Program, crew changes will be undertaken using helicopters as required. Helicopter operations within the Operational Area are limited to helicopter take-off and landing on the MODU helideck. Helicopters may be refuelled on the heli-deck of the MODU. This activity will take place within the Operational Area of the well being drilled at the time and has been included in the risk assessment for the EP.

3.5 MODU and Vessel Activities

The MODU, ISV and support vessels will use diesel-powered generators for power generation.

The MODU, ISV and support vessels will display navigational lighting and external lighting, as required for safe operations. Lighting levels will be determined primarily by operational safety and navigational requirements under relevant legislation. The MODU, ISV and support vessels will be lit to maintain operational safety on a 24-hour basis.

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

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

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

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

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

3.6 Drilling Activities

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

3.6.1 Top Hole Section Drilling

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

- The MODU arrives and establishes position over the well site;
- A pilot hole or holes may be drilled in close proximity to the intended well location. Pilot holes are used when confirmation of geology and shallow hazards is required or further understanding of the structural integrity of the rock is required. Pilot holes are drilled riserless, as described below, and result in additional cuttings, sweeps and potentially mud deposition to seabed;

- Top hole sections are drilled riserless using seawater with pre-hydrated bentonite sweeps/XC polymer sweeps or drilling fluids to circulate drilled cuttings from the wellbore; and
- Once each of the top hole sections are drilled, steel tubulars (called conductor or casing) are inserted into the wellbore to form the surface casing, and secured in place by pumping cement into the annular space back to approximately 300 m above the casing shoe, which may involve a discharge of excess cement at the seabed.

Offline Conductor Installation

An alternative method of conductor installation which may be employed during the Petroleum Activities Program is the CAN unit which is used for offline conductor installation (suction) via an ISV. The CAN is around 6 m diameter and 12-18 m in length, and is lowered down to the seabed via an ISV where an ROV is latched to the pump out port and starts pumping out water from the CAN. This creates a suction process which completes the CAN installation. Once CAN is in place, the rig comes above it and drills downwards. Using a CAN conductor minimises the volume of drill cuttings and eliminates the need for cementing conductor casing. Should the CAN installation be unsuccessful, the 36” conductor will be drilled and installed as per usual operations (drill cuttings volumes for 36” conductor have been considered in the EP).

Recovery of the CAN is proposed to be conducted with an ISV within +/- 6 months of the Ferrand-1 well finishing, pending ISV availability. The CAN is pumped out using a ROV. In the unlikely event the CAN does not come out it will be left on bottom with the wellhead in situ.

Currently CAN installation is only planned for the Ferrand-1 well, however, if the technology is successfully deployed and there is perceived benefit for future wells, it may be used again on subsequent wells considered in this Environment Plan. If the technology is used again, the CAN unit itself may be the same or a different one, depending on the technical requirements (i.e. size/dimensions) for later wells.

3.6.2 Blowout Preventer and Marine Riser Installation

After setting the surface casing, a blowout preventer (BOP) is installed on the wellhead to provide a means for sealing, controlling and monitoring the well during drilling operations. The operation of the BOP components uses open hydraulic systems (utilising water-based BOP control fluids). Each time the BOP is operated (including pressure testing approx. every 21 days and a function test approx. every 7 days, excluding the week a pressure test is conducted), the maximum volume of BOP control fluid that will be released to the marine environment per well is 1320 – 2250 L of water based fluid containing ~40 – 68 L of control fluid additive.

Hydraulic fluid used for operation of the BOP rams is subject to the chemical assessment process outlined in **Section 3.7.1**.

A marine riser is installed to provide a physical connection between the well and MODU. This enables a closed circulation system to be maintained, where weighted water based muds (WBM) or drilling fluids and cuttings can be circulated from the wellbore back to the MODU, via the riser.

3.6.3 Bottom Hole Section Drilling

A closed system (riser in place), is used for drilling bottom hole sections to the planned wellbore Total Depth (TD) (primary and success cases). Bottom hole sections are planned to be drilled using WBM drilling fluids (**Section 3.7.2**).

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

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

Cementing operations are also undertaken to:

- maintain well control and structural support of the casing as required;
- set a plug in an existing well in order to sidetrack; and
- plug a well so that it can be abandoned (**Section 3.6.7**).

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

Excess cement (dry bulk) after well operations are completed, will either be held onboard and used for subsequent wells; provided to the next operator at the end of the program or is infrequently discharged to the marine environment along with cement that does not meet technical requirements.

3.6.4 Formation Evaluation

Formation evaluation is the interpretation of a combination of measurements taken inside a wellbore to detect and quantify hydrocarbon presence in the rock adjacent to the well, once TD is reached. It may include extracting small cores, wireline logging, vertical seismic profiling (VSP), full diameter cores and other down-hole technologies, as required.

VSP is likely to be undertaken during the Petroleum Activities Program. VSP is used to generate a high-resolution seismic image of the geology in the well's immediate vicinity. It uses a small airgun array, typically comprising either a system of three 250 cubic inch airguns with a total volume of 750 cui of compressed nitrogen at about 1800 psi (12,410 kPa) or two 250 inch^3 airguns with a total volume of 500 inches^3. During VSP operations, four to five receivers are positioned in a section of the wellbore (station) and the airgun array is discharged approximately five times at 20 second intervals. The generated sound pulses are reflected through the seabed and are recorded by the receivers to generate a profile along 60 to 75 m section of the wellbore. This process is repeated as required for different stations in the wellbore and it may take up to 24 hours to complete, depending on the wellbore's depth and number of stations being profiled.

3.6.5 Well Clean-up

Prior to installing the drill stem testing (DST) string, wells will generally be displaced from the drilling fluid system to brine (referred to as well clean-up). A chemical clean-out fluids train will be circulated between the two fluids, then seawater or brine circulated until operational cleanliness specifications are met. This results in a brine and seawater discharge after this operation.

Should there be clean-up brine contaminated with base oil, it will be captured and stored on the MODU for treatment prior to discharge, or returned to shore if treatment is not possible. Initial clean-up fluids (usually returned to the rig within the first few hours of circulation) are predominantly drilling mud (concentration of mud compared to brine is a higher percentage of mud); WBM will be discharged as per requirements in the EP.

3.6.6 Drill Stem Testing

DST may also be carried out during the Petroleum Activities Program on the exploration or appraisal wells. DST involves flowing hydrocarbon fluids back to surface in a controlled manner by isolating targeted reservoir intervals with a special drill stem test bottom hole assembly, usually consisting of isolation packers and downhole valves. The test is used to determine the fluid properties and formation flow potential of the reservoir, and will vary in duration according to the test requirements. Disposal of hydrocarbons produced to surface will normally be done with flaring operations.

3.6.7 Well Abandonment

Abandonment of exploration and appraisal wells drilled as part of this Petroleum Activities Program may be required. The Petroleum Activities Program also includes the abandonment of the Noblige-1 well.

If required, wells will be abandoned with abandonment cement plugs, including verification of the uppermost cement plug by tagging and/or pressure testing through a prescribed program. Abandonment of a lower section of a well may also occur prior to sidetracking (**Section 3.8.2**).

Following abandonment activity, the marine riser and BOP will be removed, and retrieval of the wellhead and CAN (if used) will then occur.

Conventional wellheads are removed by deploying a cutting device on drill pipe which then cuts through the conductor allowing the wellhead to be retrieved to surface. Backup cutting equipment is sent offshore as a contingency should the primary set of equipment fail. The conductor cutting equipment is very reliable with a high success rate of cutting wellheads. Alternative cuttings systems are available in Perth at short notice should the need arise.

To remove the CAN if it has been used, the unit will be partially pumped out of the seabed at the end of plug and abandonment activities when the rig is on location. This is to ensure that the internal casing has been cut and that there is no restriction for removal prior to the vessel arriving to complete removal activities. An ISV will then come and pump the rest of the CAN out, however if there are geotechnical issues, it may be that the frictional forces holding the CAN in place cannot be overcome through pumping.

If these recognised removal techniques are ineffective, the wellhead may be left in-situ along with the CAN. The integrity of the wellbore is not affected by the wellhead assembly remaining in-situ (Refer to **Section 3.8.4** for additional details regarding leaving the wellhead assembly in situ).

Noblige-1 Well Re-entry and Abandonment

Timing of the well re-entry and abandonment of Noblige-1 will be subject to MODU availability. The Noblige-1 well was drilled by Woodside in 2010 under an accepted EP and was left in a suspended state, filled with approximately 180 bbls of 1.14 sg WBM, 150 bbls of 1.14 sg KCl brine and 380 bbls of inhibited seawater.

The MODU will be positioned at the Noblige-1 location and the BOP will be deployed onto the wellhead. The abandonment of Noblige-1 may include drilling through the existing cement suspension plug to gain access to the Noblige-1 wellbore to allow pumping of cement abandonment plugs. Drilled cement cuttings (8 m^3 total volume) would be discharged to sea bed in the same manner as conventional cuttings. The well will then be abandoned and BOP will be removed as outlined above.

3.7 Project Fluids

3.7.1 Assessment of Project Fluids

All downhole chemicals that may be operationally released or discharged to the marine environment by the Petroleum Activities Program are selected and approved in accordance with the Woodside Chemical Selection and Assessment Environment Guideline. This guideline is used to demonstrate that the potential impacts of the chemicals selected are acceptable and As Low as Reasonably Practicable (ALARP) and consistent with the Woodside Environmental Performance Standards Procedure.

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

Chemicals fall into the following assessment types:

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

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

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

3.7.2 Drilling Fluid System

Water Based Mud System

The Petroleum Activities Program will use a WBM drilling fluid system. In addition to the base fluid, drilling muds contain a variety of chemicals, incorporated into the selected drilling fluid system to meet specific technical requirements (e.g. mud weight required to manage pressure). All chemicals selected for use have been assessed under the *Woodside Chemical Selection and Assessment Environment Guideline*.

The WBM drilling fluid will either be mixed on the MODU or received pre-mixed, then stored and maintained in a series of pits aboard the MODU. The bottom hole sections may be drilled using WBM in a closed circulation system which enables re-use of the WBM drilling fluids (**Section**

3.7.2). The top hole sections will be drilled riserless with seawater containing pre-hydrated gum (PHG) sweeps, and cuttings and drilling fluids returned to the seabed (**Section 3.6.1**).

WBM drilling fluids that cannot be re-used (e.g. due to bacterial deterioration or do not meet required drilling fluid properties) or are mixed in excess of required volumes may be operationally discharged to the ocean after passing through the Solid Control Equipment (SCE), under the MODU's Permit to Work (PTW) system, using seawater flushing. Opportunities to reuse the WBM drilling fluids at the end of the Petroleum Activities Program are reviewed across current Woodside drilling activities.

Mud Pits

There are typically a number of mud pits (tanks) on the MODU that provide a capacity to create (mix), maintain and store fluids required for drilling activities. The mud pits form part of the drilling fluid circulation system. The mud pits and associated equipment/infrastructure are cleaned out at the completion of drilling operations. Mud pit wash residue is operationally discharged with less than 1% oil contaminated by volume. Mud pit residue over 1% oil volume is sent to shore for disposal. Due to no NWBM being present on the MODU, potential contamination would stem from the use of base oil during inflow testing prior to abandonment of a well.

3.7.3 Drill Cuttings

Drill cuttings generated from the well are expected to range from very fine to very coarse (<1 cm) particle/sediment sizes. Cuttings generated during drilling of the top hole sections are discharged at the seabed. The bottom hole sections will be drilled with a marine riser that enables cuttings and drilling fluid to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the SCE. The SCE uses shale shakers to remove coarse cuttings from the drilling mud. After processing by the shale shakers, the recovered mud from the cuttings may be directed to centrifuges, which are used to remove fine solids (4.5 to 6 µm). The cuttings are usually discharged below the water line and the mud is recirculated into the fluid system.

3.8 Unplanned Contingent Activities

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

3.8.1 Respud

A respud may be required if the conductor or well head slumps or fails installation criteria (typically during top hole drilling). Respudding involves moving the MODU to a suitably close location (e.g. ~50 m from the original location) to recommence drilling. A respud activity would result in repeating top hole drilling (**Section 3.6.1**).

3.8.2 Sidetrack

The option of a sidetrack instead of a respud may be determined if operational issues are encountered. The environmental aspects of a sidetrack well are the same as those for undertaking routine drilling activities. The net environmental effect will be limited to an increase in the volume of cuttings generated, potential increase in the use of WBM and the additional emissions (atmospheric and waste) associated with an extended drilling program.

3.8.3 Well Suspension

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

3.8.4 Wellhead Assembly Left In-situ

On completion of a well, the wellhead assembly, along with CAN (if installed), may be left in-situ if recognised removal techniques are ineffective. Well abandonment activities would be undertaken as outlined in **Section 3.6.7**, but the well assembly would remain. The integrity of the wellbore is not affected by the wellhead assembly remaining in-situ.

3.8.5 Sediment Relocation

If required, a ROV-mounted suction pump/dredging unit may be used to relocate sediment/cuttings around the wellhead to keep the area clear and safe for operations and equipment. Activity will result in located relocation of sediment material.

3.8.6 Emergency Disconnect Sequence

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

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

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 is provided below. The key existing environment characteristics are described in terms of the Permit Area and the Zone of Consequence (ZoC). The wider ZoC has been identified by hydrocarbon spill modelling of the credible worst case scenario (loss of well integrity).

The following is a summary of the main environment characteristics identified for the Permit Area and relevant to planned activities described within the EP:

- Located within offshore waters approximately 257 km north west of Dampier, within deep waters of the aphotic bathypelagic zone (1100 – 1600 m water depth over Permit Area);
- Relatively flat and featureless seabed comprising of soft sediments, including fine grained muddy sands, silts and detritus material sourced from shallower waters. There is a lack of hard substratum present in the Permit Area;
- A small (~1%) of the Exmouth Plateau Key Ecological Feature (KEF) lies within the Permit Area. The Exmouth Plateau KEF is a geomorphic feature, and may enhance upwelling of nutrient rich seawater;
- Benthic communities are expected to be of low abundance and low diversity within the Permit Area, and consistent with much of the broader Northwest Province (NWP); and
- Twenty-four species considered to be Matters of National Environmental Significance (MNES) may exist within, or transit through, the Permit Area. One Biologically Important Area (BIA) overlaps the Permit Area; a pygmy blue whale migration BIA. Small numbers of pygmy blue whales may transit the Permit Area, particularly during their annual migrations.

4.1 Physical Environment

The Permit Area is located in Commonwealth waters in the Montebello Trough which lies within the NWP within the deep waters of the aphotic bathypelagic zone. Water depths range between 1100 to 1600 m with the Permit Area and between 1000 and 3000 m within the wider NWP. The NWP is part of the wider North-west Marine Region (NWMR) as defined under the Integrated Marine and Coastal Regionalisation of Australia. The NWP is located offshore (beyond the continental shelf break) between Exmouth and Port Hedland and covers a total area of 188,730 km^2.

The climate of the NWMR is dry tropical, exhibiting a hot summer season from October to April and a milder winter season between May and September. There are often distinct transition periods between the summer and winter regimes, which are characterised by periods of relatively low winds. The region experiences a tropical monsoon climate, with distinct wet (January to July) and dry (August to November) seasons. Rainfall in the region typically occurs during the wet season, with highest falls observed during late summer, often associated with the passage of tropical low pressure systems and cyclones.

Winds vary seasonally, with a tendency for winds from the south-west during summer months (Sep – Mar) and the south-east in autumn and winter months (Apr – Aug). 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. Winds typically weaken and are more variable during the transitional period between the summer and winter regimes, generally in April and August.

Tropical cyclones are a relatively frequent event for the NWMR, with the Pilbara coast experiencing more cyclonic activity than any other region of the Australian mainland coast. Tropical cyclone activity can occur between November and April and is most frequent during December to March (i.e. considered the peak period), with an annual average of approximately one storm per month. Cyclones are less frequent in the months of November and April.

The large-scale ocean circulation of the NWMR is primarily influenced by the Indonesian Through Flow (ITF), and the Leeuwin Current. Both of these currents are significant drivers of the NWMR ecosystems. The ITF and Leeuwin Current are strongest during late summer and winter. 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.

In addition to the synoptic-scale current dynamics, tidally driven currents are a significant component of water movement in the NWMR. Tides in the NWMR are semi-diurnal and have a pronounced spring-neap cycle, with tidal currents flooding towards the south-east and ebbing towards then north-west. Wind driven currents become dominant during the neap tide. Storm surges and cyclonic events can also significantly raise sea levels above predicted tidal heights.

The bathypelagic zone in the Permit Area is characterised by cold, oxygen and nutrient rich water which receives very little (<1%) sunlight. As a result, photosynthesis is unable to take place in this zone and nearly all available nutrients result from detritus material (i.e. the remains of plants and animals) drifting down to this zone from more productive waters of the epipelagic and mesopelagic zones. The Exmouth Plateau, which overlaps the Permit Area at its east and southeast boundaries, is a region of upwelling, where deep, cool and nutrient-rich waters are forced up into the photic zone.

The offshore, oceanic seawater characteristics of the wider NWP exhibit seasonal and water depth variation in temperature and salinity, which are greatly influenced by major currents in the region. Surface waters are relatively warm year round, with temperatures reaching 30 °C in summer and dropping to 22 °C in winter. Below the thermocline, water temperature typically will continue to decrease with depth and near-seabed temperatures are expected to be very low (<6 °C).

The seabed within the Permit Area is relatively flat and featureless, aside from its east and southeast regions which overlap with approximately 1% of the Exmouth Plateau KEF. These east/southeast areas of the Permit Area comprise of a relatively flat plateau at 1100 m water depth which then slopes steeply down to where the seabed flattens again into the deep waters of the Montebello Trough.

Marine sediment in the Permit Area is expected to consist of fine grained muddy sands and silts with a lack of hard substrate, typical of the deep water seabed in the region. Carbonate sediments generally account for the bulk of sediment composition, with both biogenic and precipitated sediments present on the outer shelf.

4.2 Biological Environment

4.2.1 Habitats and Communities

No Critical Habitats or Threatened Ecological Communities as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are known to occur within the Permit Area.

Benthic Habitats

Sea floor communities in deeper shelf waters receive insufficient light to sustain ecologically sensitive primary producers such as seagrasses, macroalgae or reef-building corals. Given the depth of water at the Permit Area (approximately 1100 to 1600 m), these benthic primary producer groups will not occur in the Permit Area, but are present within the wider ZoC.

Benthic fauna surveys consistent with depths, sediment and geomorphology of the Permit Area mainly encountered echinoderms (e.g. sea cucumbers and sea stars). Distinct signs of infaunal bioturbators and potential mounds created by burrowing fish were also noted; however, abundance was found to be generally low. Although benthic filter feeders and other epifauna and infauna are likely to inhabit the Permit Area, water depth and the presence of mostly fine grained sediments with a lack of hard substrate suggests abundances and diversity will be low, and consistent with much of the broader NWP.

Within the wider ZoC, the NWMR has been identified as a sponge diversity hotspot with a variety of areas of potentially high and unique sponge biodiversity, particularly in the Commonwealth waters of Ningaloo Marine Park, 240 km from the Permit Area. Filter feeder communities in the wider ZoC region are primarily located in the deeper waters of the Ningaloo Reef system as well as the Muiron Islands, Rowley Shoals, and nearshore waters of the Pilbara Islands. Filter feeders also make up minor components of the benthic communities at Rankin Bank (approximately 111 km from the Permit Area), approximately 3% of the benthic cover, with sponges among the most abundant filter feeders. Benthic communities at Rankin Bank are similar to those recorded at other shoals in the NWMR and are considered to be representative of the broader benthic communities within the ZoC.

Plankton

Zooplankton within the Permit Area is expected to be similar to offshore waters in the NWP and may include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Peaks in zooplankton such as mass coral spawning events (typically in March and April) and fish larvae abundance can occur throughout the year.

Phytoplankton within the Permit Area and ZoC are expected to reflect the conditions of the NWMR. Primary productivity of the NWMR appears to be largely driven by offshore influences, 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.

Pelagic and Demersal Fish Populations

Fish species in the NWMR (including the Permit Area and the ZoC) comprise small and large pelagic fish, as well as demersal species. Small pelagic fish inhabit a range of marine habitats, including inshore and continental shelf waters. They feed on pelagic phytoplankton and zooplankton and represent a food source for a wide variety of predators including large pelagic fish, sharks, seabirds and marine mammals. 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 and often travel extensively.

Fish assemblage species richness in the NWMR has been shown to decrease with depth as well as be positively correlated with habitat complexity, with more complex habitat supporting greater species richness and abundance than bare areas. The Permit Area comprise predominately featureless, flat soft sediment seabed which may have hard substrates associated with the Exmouth Plateau KEF. Consequently, the fish fauna is not expected to be abundant and diversity is expected to be limited due to depth and the expected lack of hard substrate/habitat complexity.

The wider ZoC overlaps a number of important demersal fish habitats. The nearest identified important demersal fish habitat is the Continental Slope Demersal Fish Communities KEF, approximately 70 km south-east of the Permit Area. It has been identified as one of the most diverse slope assemblages in Australian waters. Additionally, diversity of demersal fish assemblages on the continental slope (south of the Permit Area) is among the highest in Australia (>500 species of which up to 76 are endemic), with the North West Cape region cited as a transition between tropical and temperate demersal and continental slope fish assemblages.

4.2.2 Species

A total of 69 EPBC Act listed species considered to be MNES (i.e. listed as threatened or migratory) were identified as potentially occurring within the wider ZoC, of which a subset of 24 were identified as potentially occurring within the Permit Area (**Table 4-1**).

Table 4-1: Threatened and migratory marine species under the EPBC Act potentially occurring with the Permit Area or within the wider ZoC

Species Name	Common Name	Threatened Status	Migratory Status	Permit Area / ZoC
Mammals				
Balaenoptera borealis	Sei whale	Vulnerable	Migratory	Permit Area
Balaenoptera musculus	Blue whale	Endangered	Migratory	
Balaenoptera physalus	Fin whale	Vulnerable	Migratory	
Megaptera novaeangliae	Humpback whale	Vulnerable	Migratory	
Balaenoptera bonaerensis	Antarctic minke whale, dark-shoulder minke whale	N/A	Migratory	
Balaenoptera edeni	Bryde's whale	N/A	Migratory	
Orcinus orca	Killer whale, orca	N/A	Migratory	
Physeter macrocephalus	Sperm whale	N/A	Migratory	
Balaena glacialis australis	Southern right whale	Endangered	Migratory	ZoC
Dugong dugon	Dugong	N/A	Migratory	
Sousa chinensis	Indo-Pacific humpback dolphin	N/A	Migratory	
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	N/A	Migratory	
Neophoca cinerea	Australian sea-lion, Australian sea lion	Vulnerable	N/A	
Reptiles				
Caretta caretta	Loggerhead turtle	Endangered	Migratory	Permit Area
Chelonia mydas	Green turtle	Vulnerable	Migratory	
Dermochelys coriacea	Leatherback turtle, leathery turtle, luth	Endangered	Migratory	
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory	
Natator depressus	Flatback turtle	Vulnerable	Migratory	
Aipysurus apraefrontalis	Short-nosed seasnake	Critically endangered	N/A	ZoC
Sharks, Sawfish and Rays				
Carcharodon carcharias	White shark, great white shark	Vulnerable	Migratory	Permit Area
Isurus oxyrinchus	Shortfin mako, mako shark	N/A	Migratory	
Isurus paucus	Longfin mako	N/A	Migratory	

Manta birostris	Giant manta ray, chevron manta ray, Pacific manta ray, pelagic manta ray, oceanic manta ray	N/A	Migratory	
Anoxypristis cuspidata	Narrow sawfish, knifetooth sawfish	N/A	Migratory	ZoC
Lamna nasus	Porbeagle, mackerel shark	N/A	Migratory	
Manta alfredi	Reef manta ray, coastal manta ray, inshore manta ray, Prince Alfred's ray, resident manta ray	N/A	Migratory	
Pristis clavata	Dwarf sawfish, Queensland sawfish	Vulnerable	Migratory	
Pristis zijsron	Green sawfish, dindagubba, narrowsnout sawfish	Vulnerable	Migratory	
Rhincodon typus	Whale shark	Vulnerable	Migratory	
Carcharias taurus	Grey nurse shark (west coast population)	Vulnerable	N/A	
Birds				
Calidris canutus	Red knot, knot	Endangered	Migratory	Permit Area
Actitis hypoleucos	Common sandpiper	N/A	Migratory	
Anous stolidus	Common noddy	N/A	Migratory	
Calidris acuminata	Sharp-tailed sandpiper	N/A	Migratory	
Calidris melanotos	Pectoral sandpiper	N/A	Migratory	
Fregata ariel	Lesser frigatebird, least frigatebird	N/A	Migratory	
Fregata minor	Great frigatebird, greater frigatebird	N/A	Migratory	
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A	ZoC
Calidris ferruginea	Curlew sandpiper	Critically endangered	Migratory	
Diomedea amsterdamensis	Amsterdam albatross	Endangered	Migratory	
Diomedea epomophora (sensu stricto)	Southern royal albatross	Vulnerable	Migratory	
Diomedea exulans (sensu lato)	Wandering albatross	Vulnerable	Migratory	
Limosa lapponica baueri	Bar-tailed godwit (baueri), western Alaskan bar-tailed godwit	Vulnerable	Migratory	
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit, bar-tailed godwit (menzbieri)	Critically endangered	Migratory	
Macronectes giganteus	Southern giant-petrel, southern giant petrel	Endangered	Migratory	
Macronectes halli	Northern giant petrel	Vulnerable	Migratory	

Numenius madagascariensis	Eastern curlew, far eastern curlew	Critically endangered	Migratory	
Papasula abbotti	Abbott's booby	Endangered	N/A	
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	N/A	
Sternula nereis nereis	Australian fairy tern	Vulnerable	N/A	
Thalassarche carteri	Indian yellow-nosed albatross	Vulnerable	Migratory	
Thalassarche cauta cauta	Shy albatross, Tasmanian shy albatross	Vulnerable	Migratory	
Thalassarche cauta steadi	White-capped albatross	Vulnerable	Migratory	
Thalassarche impavida	Campbell albatross, Campbell black-browed albatross	Vulnerable	Migratory	
Thalassarche melanophris	Black-browed albatross	Vulnerable	Migratory	
Ardenna carneipes	Flesh-footed shearwater, fleshy-footed shearwater	N/A	Migratory	
Ardenna pacifica	Wedge-tailed shearwater	N/A	Migratory	
Calonectris leucomelas	Streaked shearwater	N/A	Migratory	
Hydroprogne caspia	Caspian tern	N/A	Migratory	
Onychoprion anaethetus	Bridled tern	N/A	Migratory	
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory	
Sterna dougallii	Roseate tern	N/A	Migratory	
Sternula albifrons	Little tern	N/A	Migratory	
Charadrius veredus	Oriental plover, oriental dotterel	N/A	Migratory	
Glareola maldivarum	Oriental pratincole	N/A	Migratory	
Pandion haliaetus	Osprey	N/A	Migratory	
Thalasseus bergii	Crested tern	N/A	Migratory	
Tringa nebularia	Common greenshank, greenshank	N/A	Migratory	
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory	

Species in the Permit Area

Several species of cetaceans were identified as potentially occurring within the Permit Area, including sei, blue / pygmy blue, fin, humpback, Antarctic minke, Bryde's and sperm whales. A migration BIA for pygmy blue whales overlaps the Permit Area during their annual seasonal migration, with peak past Exmouth towards Indonesia (April – August), southerly return following WA coastline (October – late January). Humpback whales are also present in the region seasonally during migration, but are restricted to continental shelf waters; humpback whales are not expected to occur in the Permit Area. Other cetacean species may infrequently transit the Permit Area; however, the Permit Area does not represent any critical habitat (feeding, resting or breeding aggregation areas) for cetacean species that may occur in the region.

Five of the six marine turtle species recorded for the NWMR have the potential to occur within the Permit Area and wider ZoC; the loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle and the flatback turtle. There is no emergent habitat within the Permit Area, and therefore, nesting aggregations of marine turtles would not be expected. No known marine turtle BIAs overlap the Permit Area, but a number occur within the wider ZoC, relating to four of the five species identified (excluding leatherback turtles).

Several shark/ray species, including the great white shark, shortfin mako, longfin mako and giant manta ray may be present within the Permit Area, for short durations when individuals transit the area.

The Permit Area may be occasionally visited by oceanic birds, such as petrels, but does not contain any emergent land that could be utilised as roosting or nesting habitat and contains no known critical habitats for any species.

Species in the Wider Region

In addition to the marine mammals identified within the Permit Area, other species of marine mammal are expected to occur in the wider region, including whales, coastal and oceanic dolphins, dugongs (associated with seagrass habitats) and Australian sea lions (closest known colony at the Abrolhos Islands).

Seasnakes occur in the NWMR and are reported to occur in offshore and nearshore waters. They occupy diverse habitats including coral reefs, turbid water habitats and deeper water. Species exhibit habitat preferences depending on water depth, benthic habitat, turbidity and season. The short-nosed seasnake, as well as other non-MNES species will occur throughout the wider ZoC, but are unlikely to be present in the Permit Area.

Whale sharks are present in the NWMR from March to November, corresponding with the whale shark's seasonal migration to and from the Ningaloo Reef. Timing of the whale sharks' migration to and from Ningaloo coincides with the coral mass spawning period and period of high productivity when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo Reef. Satellite tracks of whale sharks moving in a north-east direction show individuals do transit the Permit Area; however, whale sharks were not identified as occurring within the Permit Area from the Protected Matters Search report.

Offshore islands in the wider region, including Montebello/Barrow/Lowendal Island Groups, Muiron Islands and Shark Bay are important seabird and shorebird nesting and foraging habitats.

4.2.3 Socio-economic and Cultural

Heritage

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

Ramsar Wetlands

There are no Ramsar-listed wetlands in the Permit Area.

Commonwealth and State Fisheries

Little fishing effort occurs in the Permit Area due to the water depth and distance from shore. Commonwealth fisheries designated management areas within the Permit Area and wider region include the following:

- North West Slope Trawl Fishery;
- Southern Bluefin Tuna Fishery;
- Western Deepwater Trawl Fishery;
- Western Skipjack Fishery; and

- Western Tuna and Billfish Fishery.

State fisheries designated management areas within or adjacent to the Permit Area include the following:

- Abalone Managed Fishery;
- Abrolhos Islands and Mid-West Trawl Managed Fishery;
- Broome Prawn Managed Fishery;
- Exmouth Gulf Prawn Managed Fishery;
- Gascoyne Demersal Scalefish Managed Fishery;
- Mackerel Managed Fishery;
- Marine Aquarium Managed Fishery;
- Nickol Bay Prawn Managed Fishery;
- Northern Demersal Scalefish Managed Fishery;
- Onslow Prawn Managed Fishery;
- Pearl Oyster Managed Fishery;
- Pilbara Demersal Scalefish Managed Fisheries (Pilbara Trawl, Trap and Line);
- Shark Bay Blue Swimmer Crab Fishery;
- Shark Bay Prawn and Scallop Managed Fisheries;
- South West Coast Salmon Managed Fishery;
- Specimen Shell Managed Fishery;
- West Coast Deep Sea Crustacean Managed Fishery;
- West Coast Demersal Gillnet & Longline Fishery;
- West Coast Demersal Scalefish Fishery; and
- West Coast Rock Lobster Fishery.

There are no aquaculture activities within or adjacent to the Permit Area.

There are no traditional, or customary, fisheries within the Permit Area, as these are typically restricted to shallow coastal waters and/or areas with structure such as reef.

Tourism and Recreation

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

Due to the Permit Area’s water depths (between 1100 and 1600 m) and distance offshore (approximately 243 km north-west of Onslow), recreational fishing is unlikely to occur in the Permit Area.

Shipping

No shipping fairways intersect the Permit Area; however, a major route to and from the port of Fremantle lies approximately 40 km west of the Permit Area (**Figure 4-1**). Data provided through consultation with AMSA confirms vessel traffic does currently occur within the Permit Area (data from March to May 2017), but is sparse. Traffic associated with the main shipping fairway to the west of the Permit Area is mainly within, or to the west of the fairway.

The broader NWMR supports significant commercial shipping activity, the majority of which is associated with the mining and oil and gas industries. Additional shipping routes are located within the wider ZoC, and it is expected that local vessel traffic will pass through the area. Shipping activities in the region include (**Figure 4-1**):

- International bulk freighters/tankers including mineral ore, hydrocarbons (liquefied natural gas, liquefied petroleum gas, condensate) and salt carriers;
- Domestic support/supply vessels servicing offshore facilities and barrow island development;
- Construction vessels/barges/dredges;
- Offshore survey vessels; and
- Commercial and recreational fishing vessels.

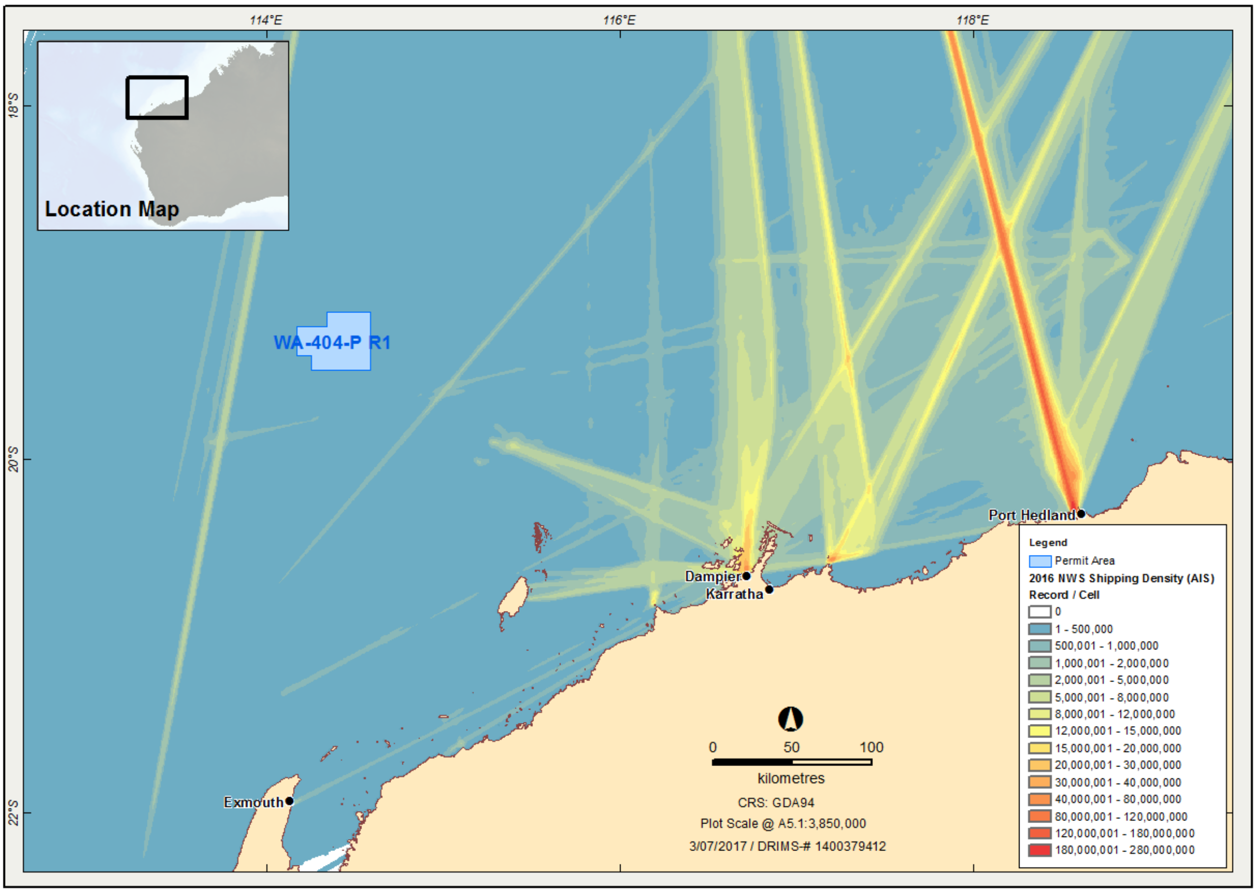

Figure 4-1: Vessel density map for the Permit Area from 2016, derived from AMSA satellite tracking system data

Oil and Gas Infrastructure

The Permit Area is located within an area of established oil and gas operations in the broader NWMR. The Permit Area is approximately 96 km north-west of the Wheatstone Platform and 99 km north-west of the Pluto platform; Chevron and Woodside are the operators of these facilities. Several Floating Production Storage and Offloading (FPSO) units are currently in operation in the wider vicinity of the Permit Area and within the ZoC. Additionally, 10 wells (including Noblige-1) are located within the Permit Area; the most recent was plugged and abandoned approximately six years ago.

Defence

There are designated defence practice areas in the offshore marine waters off Ningaloo and the North West Cape. No known defence areas overlap the Permit Area; however, there are designated defence practice areas in the offshore marine waters off Ningaloo and the North West Cape, within the wider ZoC. A Royal Australian Air Force base is located at Learmonth, on North West Cape, lies approximately 300 km south of the Permit Area.

4.3 Values and Sensitivities

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 Islands, Barrow Island, and the Ningaloo World Heritage Area, and the associated resident, temporary or migratory marine life including species such as marine mammals, turtles and birds.

Many sensitive receptor locations are protected as part of Commonwealth and State managed areas (**Figure 4-2**) and have been allocated conservation objectives (IUCN Protected Area Category) based on the Australian IUCN reserve management principles.

The closest marine protected area is the Montebello Commonwealth Marine Reserve, which lies approximately 89 km south-east of the Permit Area. One KEF, the Exmouth Plateau, partially overlaps the Permit Area. Distances from the Permit Area to environmentally sensitive areas within the wider region are provided in **Table 4-2**.

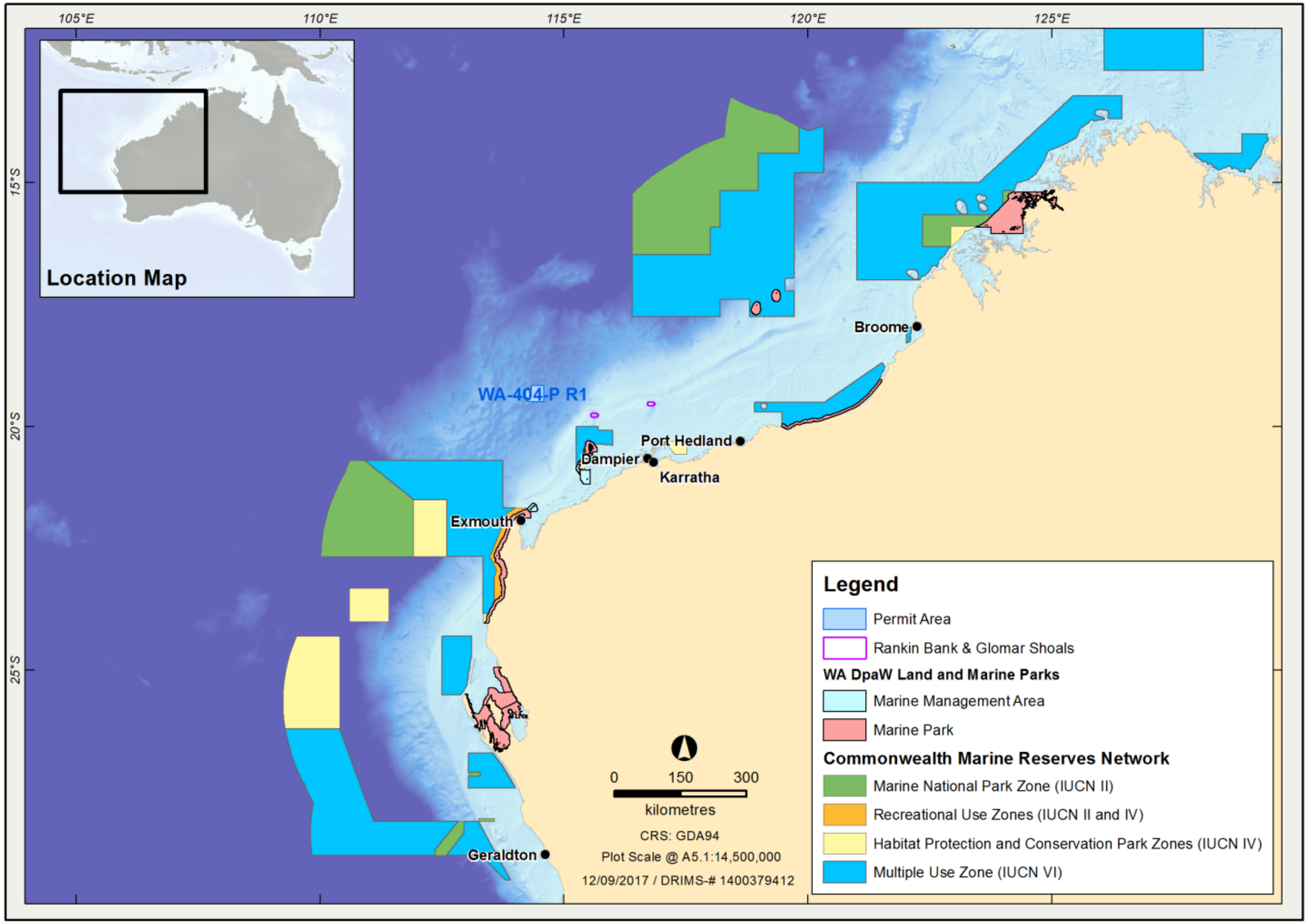

Figure 4-2: Commonwealth and State Marine Protected Areas in relation to the Permit Area

Table 4-2: Summary of established Marine Protected Areas (MPAs) and other sensitive locations in the region relating to the Permit Area

	Distance from Permit Area to Values / Sensitivity boundaries (km)	IUCN Protected Area Category
Commonwealth Marine Reserves		
Montebello	89	VI
Gascoyne	143	II, IV & VI
Ningaloo	240	IV
Argo-Rowley Terrace	248	II & VI
Carnarvon Canyon	517	IV
Shark Bay	545	VI
Abrolhos	666	II, IV & VI
State Marine Parks and Reserves		
Marine Parks		
Montebello Islands	129	IA, II & IV
Barrow Island	155	IA & VI
Ningaloo	243	IA, II & IV
Rowley Shoals (including Imperieuse Reef)	485	IA, II & IV
Marine Management Areas		
Muiron Islands	230	1A & VI
Barrow Island	154	1A & VI
Fish Habitat Protection Areas		
None identified in Permit Area or ZoC	-	-
Proposed Marine Park		
None identified in Permit Area or ZoC	-	-
World Heritage Areas		
Ningaloo	230	N/A
Shark Bay	588	N/A
Key Ecological Features		
Exmouth Plateau	Overlaps Permit Area	N/A
Continental Slope Demersal Fish Communities	70	N/A
Ancient coastline at 125 m depth contour	88	N/A
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	209	N/A
Commonwealth waters adjacent to Ningaloo Reef	240	N/A
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	472	N/A

	Distance from Permit Area to Values / Sensitivity boundaries (km)	IUCN Protected Area Category
Wallaby Saddle	680	N/A
Western demersal slope and associated fish communities	697	N/A
Western rock lobster	910	N/A
Ancient coastline at 90-120m depth	911	N/A

**Conservation objectives for IUCN categories in Table 4-2 include:*

- *IA: Strict nature reserve – Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.*
- *II: National park – Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for this and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.*
- *IV: Habitat / species management area – Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.*
- *VI: Protected area with sustainable use of natural resources – Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.*

5. ENVIRONMENTAL IMPACTS AND RISKS

5.1 Risk Identification and Evaluation

Woodside undertook an environmental risk assessment to identify the potential environmental impacts and risks associated with the Petroleum Activities Program, and the control measures to manage the identified environmental impacts and risks to ALARP and an acceptable level. This risk assessment and evaluation was undertaken using Woodside's Risk Management Framework.

The key steps of Woodside's Risk Management Framework are shown in **Figure 5-1**. A summary of each step and how it is applied to the Petroleum Activities Program is provided below.

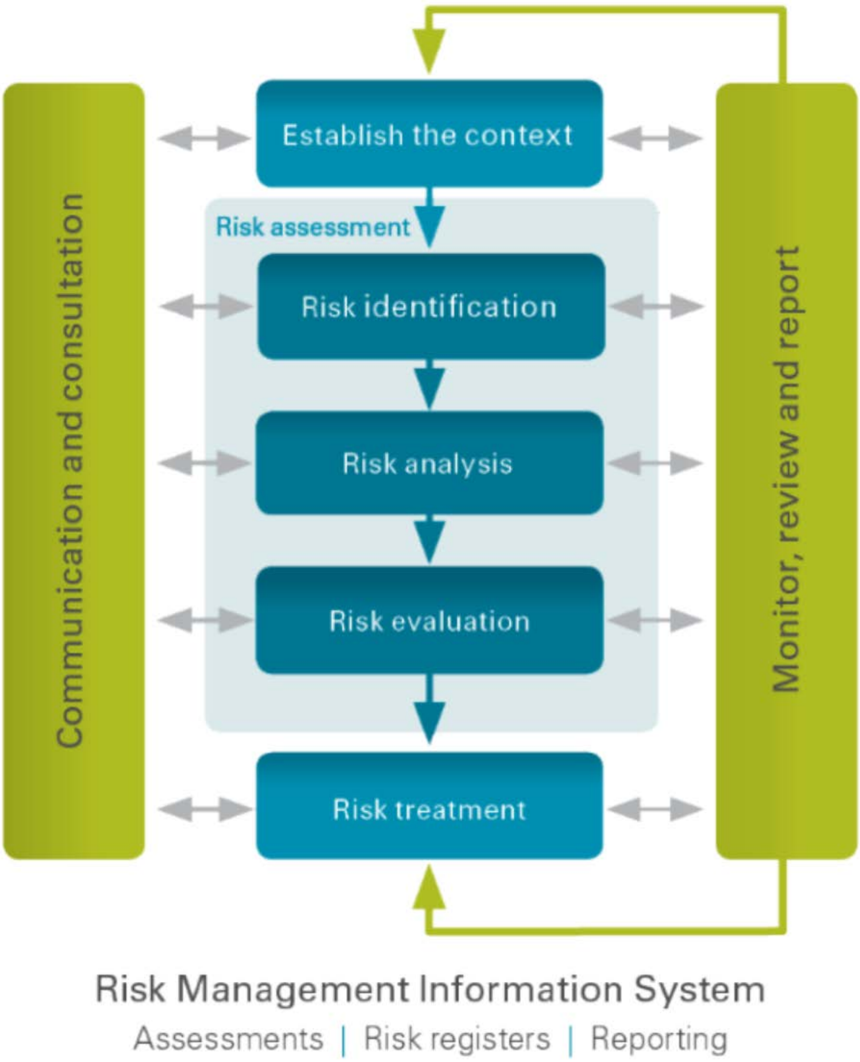

Figure 5-1: Woodside's risk management framework

5.1.1 Establish the Context

The objective of a risk assessment is to assess identified risks and apply appropriate control measures to eliminate, control or mitigate the risk to ALARP and to determine if the risk is acceptable.

Hazard identification workshops aligned with NOPSEMA's Hazard Identification Guidance Note were undertaken by multidisciplinary teams made up of relevant personnel with sufficient breadth of knowledge, training and experience to reasonably assure that risks and associated impacts were identified and assessed.

5.1.2 Risk Identification

The risk assessment workshop for the Petroleum Activities Program was used to identify risks with the potential to harm the environment. Risks were identified for both planned (routine and non-routine) and unplanned (accidents/incidents) activities.

5.1.3 Risk Analysis (Decision Support Framework)

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

The following key steps were undertaken for each identified risk during the risk assessment and are described in the following sections:

- Identification of decision type in accordance with the decision support framework;
- Identification of appropriate control measures (preventative and mitigation) aligned with the decision type; and
- Calculation of the current risk rating.

To support the risk assessment process, Woodside applied the Guidance on Risk Related Decision Making (Oil and Gas UK 2014) during the workshops 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. This is to confirm:

- Activities do not pose an unacceptable environmental risk;
- Appropriate focus is placed on activities where the risk is anticipated to be acceptable and demonstrated to be ALARP; and
- Appropriate effort is applied to the management of risks based on the uncertainty of the risk, the complexity and risk rating.

The framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the risk (referred to as the decision type A, B or C). The decision type is selected based on an informed discussion around the uncertainty of the risk, and it is agreed by environmental hazard identification (ENVID) workshop participants and documented in ENVID worksheets.

Identification of Control Measures

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

- **Legislation, Codes and Standards (LCS)** – identifies the requirements of legislation, codes and standards which are to be complied with for the activity;
- **Good Industry Practice (GP)** – identifies further engineering control standards and guidelines which may be applied by Woodside above that required to meet the legislation, codes and standards;
- **Professional Judgment (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. The general hierarchy of control applied is as follows:
  - elimination of the risk by removing the risk;

- substitution of a risk with a less hazardous one; or
- engineering control measures to include measures to prevent the risk event or control the magnitude of a risk event;

- **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 (CS)** – identifies values identified in Woodside's code of conduct, policies and the Woodside compass. Views, concerns and perceptions are to be considered from internal Woodside stakeholders directly affected by the planned or potential risk; and
- **Societal Values (SV)** – identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder views, concerns and perceptions.

5.1.4 Current Risk Rating Process

The current risk rating process is undertaken to assign a level of risk to each impact measured in terms of consequence and likelihood. The assigned risk level is the current risk (i.e. risk with controls in place) and is therefore determined following the identification of the decision type and appropriate control measures.

The risk rating process considers the environmental impacts and where applicable, the reputational and brand, legal/compliance and social and cultural impacts of the risk. The risk ratings are assigned using the Woodside Risk Matrix (refer to **Figure 5-2**).

Consequence

	Health & Safety	Environment	Financial	Reputation & Brand	Legal & Compliance	Social & Cultural
A	> 30 fatalities and / or permanent total disabilities	Catastropic, long-term impact (> 50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	> $5B	Catastrophic, long term impact (> 20 years) to reputation and brand. International concern and / or persistent national concern in significant area of operation. Company operations, major ventures, significant or multiple asset operations severely restricted or terminated, and may extend to company at stake	Loss of licence to operate. Potential jail terms for executives, directors or officers. Prolonged litigation / prosecution. Fines (> $100M) and / or civil liability (> $1B)	Catastrophic, long-term impact (> 20 years) to a community, social infrastructure or highly valued areas / items of international cultural significance
B	Multiple fatalities and / or permanent total disabilities	Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	> $500M - $5B	National concern and / or international interest. Medium to long-term impact (5-20 years) to reputation and brand. Venture and / or asset operations restricted	Significant restriction on licence to operate. Prolonged litigation / prosecution. Fines (< $100M) and / or civil liability (< $1B)	Major, long-term impact (5-20 years) to a community, social infrastructure or highly valued areas / items of national cultural significance
C	Single fatality and / or permanent total disability	Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	> $50M - $500M	National concern. Moderate, medium-term impact (2-5 years) to reputation and brand. Venture and / or asset operations restricted or curtailed	Material breach of legislation, regulation, contract or licence condition. Major litigation / prosecution. Fines (< $15M) and / or civil liability (< $150M)	Moderate, medium-term impact (2-5 years) to a community, social infrastructure or highly valued areas / items of national cultural significance
D	Major injury or occupational illness or permanent partial disability	Minor, short-term impact (1-2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes	> $5M - $50M	Minor, short-term impact (1-2 years) to reputation and brand. Close scrutiny of asset level operations or future proposals	Breach of legislation, regulation, contract or licence condition with investigation and / or report to authority. Litigation / prosecution. Fines (< $5M) and / or civil liability (< $50M)	Minor, short-term impact (1-2 years) to a community or highly valued areas / items of cultural significance
E	Moderate injury or occupational illness or temporary partial disability	Slight, short-term impact (< 1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	> $500K - $5M	Slight, short-term local impact (< 1 year) to reputation and brand. Some impact on asset level non-production activities	Breach of legislation, regulation, contract or licence condition. Regulatory action and / or sanction	Slight, short-term impact (< 1 year) to a community or areas / items of cultural significance
F	Minor injury or occupational illness	No lasting effect (< 1 month). Localised impact not significant to environmental receptors	≤ $500K	No lasting effect (< 1 month). Isolated and short-term local concern	Breach of internal standard	No lasting effect (< 1 month). Localised impact not significant to areas / items of cultural significance

Likelihood

	Remote	Highly Unlikely	Unlikely	Possible	Likely	Highly Likely
Experience	Unheard of in the industry	Has occurred once or twice in the industry	Has occurred many times in the industry but not at Woodside	Has occurred once or twice in Woodside or may possibly occur	Has occurred frequently at Woodside or is likely to occur	Has occurred frequently at the location or is expected to occur
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
Modelled distribution %* (Probability of event occurrence)	< 1%	1% - 5%	6% - 20%	21% – 50%	51% - 80%	> 80%
LEVEL	0	1	2	3	4	5

** Not to be used for operational Health & Safety or Environment risk assessments.*

LEVEL	0	1	2	3	4	5
A	A0	A1	A2	A3	A4	A5
B	B0	B1	B2	B3	B4	B5
C	C0	C1	C2	C3	C4	C5
D	D0	D1	D2	D3	D4	D5
E	E0	E1	E2	E3	E4	E5
F	F0	F1	F2	F3	F4	F5

Risk endorsement table

Current Risk

SEVERE	Risk at this level requires **Immediate (no more than 12 hours)** communication to the **CEO & divisional EVP / SVP** via VP Risk & Compliance
VERY HIGH	Risk at this level requires **Immediate (no more than 12 hours)** communication to **divisional EVP / SVP** with concurrent communication to VP Risk & Compliance
HIGH	Risk at this level requires timely communication to **SVP / VP of business unit or function**
MODERATE	Risk at this level requires timely communication to **line manager** (i.e. relevant Asset or Project Manager)
LOW	Risk at this level requires timely communication to the relevant **line manager**

Note: All currency stated in $US. The consequence and likelihood categories are not necessarily equal to each other. For example, the financial column is not equal to the remediation costs or consequences described in other columns.

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Figure 5-2: Woodside risk matrix

The ENVID (undertaken in accordance with the methodology described above) identified 20 sources of environmental risk, comprising nine planned, which are all assessed as having a low current risk rating, and eleven unplanned sources of risk, which are assessed as having a low to high current risk rating following the implementation of identified preventative and mitigation control measures. Control measures have been presented in **Appendix A**. Oil spill mitigation controls are also presented in **Appendix B**.

The risk analysis and evaluation for the Petroleum Activities Program indicate that all of the current environmental risks and impacts associated with the activity are reduced to ALARP and are of an acceptable level.

5.1.5 Risk Evaluation

Environmental risks, as opposed to safety risks, cover a wider range of issues, differing species, persistence, reversibility, resilience, cumulative effects and variability in severity. The degree of environmental risk and the corresponding threshold for whether a risk/impact has been reduced to ALARP and is acceptable (refer to **Figure 5-2**) has been adapted to include principles of ecological sustainability (given as an objective in the Environment Regulations and defined in the EPBC Act), the Precautionary Principle and the corresponding environmental risk threshold decision-making principles used to determine acceptability.

With regard to assigned consequence and likelihood as per the Woodside Risk Matrix (**Figure 5-2**), it should be noted that the application of a consequence can relate to both an impact and/or a risk. When considering likelihood for planned impacts, the likelihood level assigned relates to the risk that the impact could exceed that of the defined impact (for example, could discharge of drill cuttings impact a greater area than planned).

Demonstration of ALARP

In accordance with Regulation 10A(b) of the Environment Regulations, Woodside demonstrates risks are reduced to ALARP where:

The current risk is Low or Moderate:

- Good industry practice or comparable standards have been applied to control the risk, because any further effort towards risk reduction is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.

The current risk is High, Very High or Severe:

- Good industry practice is applied for the situation/risk;
- Alternatives have been identified and the control measures selected reduce the risks and impacts to ALARP. This may require assessment of Woodside and industry benchmarking, review of local and international codes and standards, consultation with stakeholders etc.

In addition, when a current risk is at a high level is it communicated to the Senior Vice President (SVP) / Vice President (VP) of the business unit or function, and a current risk level of very high or severe communication to the divisional Executive Vice President / SVP with concurrent communication to the VP of Risk and Compliance.

Demonstration of Acceptability

In accordance with Regulation 10A(c) of the Environmental Regulations, Woodside applies the following process to demonstrate acceptability:

- Low and Moderate current risks are 'Broadly Acceptable', if they meet legislative requirements, industry codes and standards, regulator expectations, Woodside Standards and industry guidelines.
- High to Severe risks are ‘Acceptable’ if ALARP can be demonstrated using good industry practice and risk based analysis (RBA), 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 following criteria:

  - Principles of Ecologically Sustainable Development (ESD) as defined under the EPBC Act;
  - Internal context – the proposed controls and current risk level are consistent with Woodside policies, procedures and standards;
  - External context – consideration of the environment consequence and stakeholder acceptability; and
  - Other requirements – the proposed controls and current risk level are consistent with national and international standards, laws and policies.
- Very High and Severe current risks require further investigation and mitigation to reduce the risk to a lower and more acceptable level. If after further investigation the risk remains in the severe category, the risk requires appropriate business sign-off to accept the risk.

5.2 Hydrocarbon Spill Risk Assessment Methodology

Quantitative hydrocarbon spill modelling was undertaken using a three-dimensional hydrocarbon spill trajectory and weathering model which is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of changing meteorological and oceanographic forces.

5.2.1 ZoC and Hydrocarbon Contact Thresholds

The outputs of the quantitative hydrocarbon spill modelling are used to assess the environmental risk, if a credible hydrocarbon spill scenario occurred, solely in terms of delineating which areas of the marine environment could be exposed to hydrocarbon levels exceeding hydrocarbon threshold concentrations. All areas where hydrocarbon levels are exceeded are evaluated in the impact assessment. As the weathering of different fates of hydrocarbons (surface, accumulated, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, the locations potentially affected by each fate will differ.

The summary of all the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the ZoC. A stochastic modelling approach was applied to the quantitative hydrocarbon spill modelling. Stochastic modelling is the combination of a number of individual spill trajectory simulations, modelled under a range of historical metocean data considered seasonally and geographically representative for the scenario modelled. The stochastic results indicate the probability of where hydrocarbon might travel and the time take by the hydrocarbon to reach a given sensitive receptor for all modelled simulations. When considering the ZoC, it is important to understand that the ZoC does not represent the extent of any single spill event, which would be significantly smaller in spatial extent than a ZoC presenting stochastic modelling probabilities.

Surface fate and shoreline accumulation concentrations are expressed as grams per square metre (g/m^2), with entrained and dissolved aromatic hydrocarbon concentrations expressed as parts per billion (ppb). Hydrocarbon thresholds are presented in the table below (**Table 5-1**) and described in the following subsections.

Table 5-1: Summary of thresholds applied to the quantitative hydrocarbon spill risk modelling results

Surface Hydrocarbon (g/m^2)	Entrained hydrocarbon (ppb)	Dissolved aromatic hydrocarbon (ppb)	Accumulated Hydrocarbon (g/m^2)
10	500	500	100

Surface Hydrocarbon Threshold Concentrations

The spill modelling outputs defined 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. 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 (for example: 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 approximately 10–25 g/m^2.

Dissolved Aromatic Hydrocarbon Threshold Concentrations

The threshold concentration value for dissolved aromatic hydrocarbons has been set with reference to results from ecotoxicity tests. Ecotox data from a surrogate hydrocarbon that is considered to be representative of hydrocarbon that may be encountered during the Petroleum Activities Program is used to determine thresholds where data is not available for the exact resource location. The purpose of the threshold is to inform the assessment of the potential for toxicity impacts to sensitive marine biota. The ecotoxicity tests were undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well established. These ecotoxicology tests are focused on the early life stages of test organisms, when organisms are typically at their most sensitive. The ecotoxicology tests were conducted on six mainly tropical-subtropical species representatives from six major taxonomic groups.

Based on these ecotoxicology tests, a dissolved aromatic hydrocarbon threshold of 500 ppb has been adopted. This 500 ppb threshold is significantly less than the lowest no observable effect concentration (NOEC) for the most sensitive organism tested. Therefore, it is considered that the 500 ppb dissolved aromatic threshold is a conservative threshold to apply to condensate that may be encountered during the Petroleum Activities Program.

Entrained Hydrocarbon Threshold Concentrations

The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for water accommodated fraction (WAF) of hydrocarbons. However, it is likely these data specific to dissolved hydrocarbon represents a worst-case scenario. This is owing to the fact that entrained hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved hydrocarbons. It is therefore expected that the entrained threshold concentration of 500 ppb will represent a potential impact substantially lower than the NOEC concentrations.

Accumulated Hydrocarbon Threshold Concentrations

Published data define accumulated hydrocarbon <100 g/m^2 to have an appearance of a stain on shorelines, with an accumulated hydrocarbons ≥100 g/m^2 considered to be the threshold that could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat.

6. ENVIRONMENTAL RISKS AND IMPACTS SUMMARY

Table 6-1 presents a summary of the sources of risk, analysis and evaluation for the Petroleum Activities program, using the methodology described above in **Section 5** of this EP Summary. There are two types of environmental risk sources identified for the Petroleum Activities Program:

- Planned activities (undertaken on a routine or non-routine basis); and
- Unplanned activities (accidents or emergencies).

These sources of risk range from small scale chemical spills with a low environmental consequence to hydrocarbon spill events with high environmental consequence.

A detailed description of environmental risks and potential impacts together with a summary of control measures have been presented in **Appendix A**.

Table 6-1: Environmental risk and impacts register summary

Aspect	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Current Risk Rating				Acceptability of Risk
			Consequence	Potential Consequence level of impact[2]	Likelihood	Current Risk Rating	
Planned Activities (Routine and Non-routine)							
Physical presence	Displacement of other users - proximity of MODU, ISVs and support vessels causing interference with or displacement to third party vessels (commercial fishing, recreational fishing and commercial shipping).	Isolated social impact potentially resulting from interference with other sea users (e.g. commercial and recreational fishing, and shipping)	E	Social and Cultural – Slight, short-term impact (<1 year) to a community or area/items of cultural significance	1	L	Broadly acceptable
	Disturbance to seabed from: • Drilling operations • Re-entry and plug and abandonment of Noblige-1 • Installation of conductor with CAN • ROV operations • MODU holding station (seabed transponders for DP MODU and anchoring for moored MODU) • Disturbance to seabed from wellhead remaining in-situ (if required)	Localised disturbance to benthic habitats from anchoring and drilling operations	E	Environment – slight, short term local impact (< 1 Year) on habitat. But no affecting ecosystems function.	1	L	Broadly acceptable
Routine acoustic emissions	Generation of acoustic signals from VSP	Temporary and minor disruption (e.g. avoidance) to fauna, including protected species.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. protected species).	2	L	Broadly acceptable
	Generation of acoustic signals from: • Drilling, support vessels and ISV during normal operations • Dynamic positioning systems on DP MODU • Generation of atmospheric noise from helicopter transfers	Temporary and minor disruption (e.g. avoidance or attraction) to fauna, including protected species.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. protected species).	1	L	Broadly acceptable
Routine and non-routine discharges	Discharge from MODU, support vessels and ISV of: • Sewage • Grey water • Putrescible waste • Bilge water • Deck drainage • Cooling water or brine	Localised and temporary effects to water quality and marine biota in offshore waters.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. water quality).	2	L	Broadly acceptable
	Routine and non-routine discharge of: • WBM drill cuttings • Drilling muds (WBM) • Wash water from mud pits • Well clean-up fluids • Well annular fluids from abandoned wells	Localised burial and smothering of benthic habitats. Localised and temporary slight effects to water quality (e.g. turbidity increase) and marine biota in offshore waters	E	Environment – slight, short term local impact (< 1 Year) on species, habitat (But not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
	Routine discharge of cement, cement cuttings, cementing fluids and subsea fluids (e.g. BOP control fluids and well suspension fluids) to the seabed and the marine environment.	Localised burial and smothering of benthic habitats. Localised and temporary slight effects to water quality (e.g. turbidity increase) and marine biota in offshore waters	E	Environment – slight, short term local impact (<1 Year) on species, habitat (But not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Routine atmospheric emissions	Atmospheric emissions from fuel combustion, flaring (including DST) and incineration.	Reduced local air quality from atmospheric emissions	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. air quality).	2	L	Broadly acceptable
Routine light emissions	External Lighting on MODU, ISV and Support Vessels	Disturbance to marine fauna, particularly seabirds, marine turtles and fish.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. species).	1	L	Broadly acceptable

Aspect	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Current Risk Rating				Acceptability of Risk
			Consequence	Potential Consequence level of impact[2]	Likelihood	Current Risk Rating	
Unplanned Activities (Accidents / Incidents)							
Accidental hydrocarbon release	Loss of hydrocarbons to marine environment due to loss of well integrity.	Short to medium term impacts to the offshore marine environment. Long-term impacts to sensitive nearshore areas of offshore islands (e.g. the Montebello/Barrow/Lowendal Island Group) and coastal shorelines (e.g. Ningaloo Coast). Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users (e.g. fishing and shipping).	B	Environment – Major, long term impact (10-50 years) on highly valued ecosystems, species, habitat, physical or biological attributes Reputation/brand – National concern and/or international interest. Medium to long-term impact (5-20 years) to reputation and brand. Venture and/or asset operations restricted.	2	H	Acceptable if ALARP
	Loss of hydrocarbons to marine environment due to a vessel collision (e.g. support vessels or other marine users).	Minor and temporary disruption to marine fauna, including protected species. Minor and/or temporary impacts to water quality.	D	Environment – Minor, short-term impact (1-2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Broadly acceptable
	Loss of hydrocarbons to marine environment from bunkering / refuelling.	Temporary disruption to marine fauna, including protected species. Temporary and localised impacts to water quality.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. air quality).	2	L	Broadly acceptable
Unplanned discharges	Accidental discharge of drilling fluids (WBM/base oil) to marine environment due to failure of slip joint packers, bulk transfer hose / fitting, emergency disconnect system or from routine MODU operations.	Slight and temporary disruption to marine fauna, including protected species. Slight and/or temporary impacts to water quality.	E	Environment – slight, short term local impact (<1 Year) on species, habitat (but not affecting ecosystems function), physical and biological attributes.	1	L	Acceptable if ALARP
	Venting of gas during drilling (i.e. well kick).	Localised and temporary reduction in air quality as the gas vents to the atmosphere.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. air quality).	2	L	Broadly acceptable
	Accidental discharge to the ocean of other hydrocarbons / chemicals from MODU or support vessel deck activities and equipment (e.g. cranes) including helicopter refuelling and subsea ROV hydraulic leaks.	Slight and temporary disruption to marine fauna, including protected species. Slight and/or temporary impacts to water quality.	E	Environment – slight, short term local impact (<1 Year) on species, habitat (But not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
	Accidental discharge to the ocean of hydrocarbons during DST if the flare is extinguished	Slight and temporary disruption to marine fauna, including protected species. Slight and/or temporary impacts to water quality.	E	Environment – slight, short term local impact (<1 Year) on species, habitat (But not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
	Accidental loss of hazardous or non-hazardous wastes to the marine environment (excludes sewage, grey water, putrescible waste and bilge water).	Localised and temporary impacts to water quality.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. water quality).	2	L	Broadly acceptable
Physical presence	Accidental collision between project vessels and threatened and migratory whale species.	Slight and temporary disruption to marine fauna, including protected species.	E	Environment – slight, short term local impact (<1 Year) on species, habitat (But not affecting ecosystems function), physical or biological attributes..	1	L	Broadly acceptable
	Loss of station keeping of MODU leading to seabed disturbance.	Localised disturbance of benthic habitats.	E	Environment – slight, short term local impact (<1 Year) on species, habitat (But not affecting ecosystems function), physical or biological attributes..	1	L	Broadly acceptable
	Dropped objects resulting in seabed disturbance.	Localised short-term damage of benthic subsea habitats in the immediate location of the dropped object.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. benthic habitats).	2	L	Broadly acceptable

Aspect	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Current Risk Rating				Acceptability of Risk
			Consequence	Potential Consequence level of impact[2]	Likelihood	Current Risk Rating	
	Introduction of invasive marine species (IMS)	Localised and temporary introduction of IMS into the Permit Area, which will not survive.	F	Environment – No lasting effect (<1 month) localised impact not significant to environmental receptors (e.g. benthic habitats).	0	L	Broadly acceptable

7. ONGOING MONITORING OF ENVIRONMENTAL PERFORMANCE

The Petroleum Activities Program will be managed in compliance with the WA-404-P Drilling EP accepted by NOPSEMA under the Environment Regulations, other relevant environmental legislation and Woodside's Management System (e.g. Woodside Environment Policy).

The objective of the WA-404-P Drilling EP is to identify, mitigate and manage potentially adverse environmental impacts associated with the Petroleum Activities Program, during both planned and unplanned operations, to ALARP and an acceptable level.

For each environmental aspect (risk) and associated environmental impacts (identified and assessed in the Environmental Risk Assessment of the EP) specific environmental performance outcomes, controls, environmental performance standards and measurement criteria have been developed. The control measures (available in **Appendix A**) will be implemented in accordance with the relevant environmental performance standards to achieve the environmental performance outcomes. The specific measurement criteria provide the evidence base to demonstrate that the environmental performance standards and outcomes are achieved.

The implementation strategy detailed in the WA-404-P Drilling EP identifies the roles/responsibilities and training/competency requirements for all personnel (Woodside and its contractors) in relation to implementing controls, managing non-conformance, emergency response and meeting monitoring, auditing, and reporting requirements during the activity.

Woodside and its contractors will undertake a program of periodic monitoring during the Petroleum Activities Program, starting at mobilisation of each activity and continuing through the duration of each activity until activity completion. This information is collected using appropriate tools and systems, based on the environmental performance outcomes, performance standards and measurement criteria in the WA-404-P Drilling EP.

The tools and systems collect, as a minimum, the data (evidence) referred to in the measurement criteria. The collection of this data (and assessment against the measurement criteria) forms part of the permanent record of compliance maintained by Woodside and the basis for demonstrating that the environmental performance outcomes and standards are met, which is then summarised in a series of routine reporting documents.

Monitoring of environmental performance is undertaken as part of the following:

- Environmental Performance Report will be submitted to NOPSEMA within twelve months of commencement of the activity to assess and confirm compliance with the accepted environmental performance objectives, standards and measurement criteria outlined in the WA-404-P Drilling EP;
- Activity-based inspections undertaken by Woodside's environment function to review compliance against the WA-404-P Drilling EP, verify effectiveness of the implementation strategy and to review environmental performance;
- Environmental performance is also monitored daily via daily progress reports during operations; and
- Senior management regularly monitors and reviews environmental performance via a monthly report which details environmental performance and compliance with Woodside standards.

Woodside employees and contractors are required to report all environmental incidents and non-conformance with environmental performance outcomes and standards in the WA-404-P Drilling EP. Incidents will be reported using an Incident and Hazard Report Form, which includes details of the event, immediate actions taken to control the situation, and corrective actions to prevent reoccurrence. An internal computerised database is used for the recording and reporting of these incidents. Incident corrective actions are monitored to ensure they are closed out in a timely manner.

The WA-404-P Drilling EP is supported by an assessment of the environmental impacts and risks associated with potential hydrocarbon spill scenarios and hydrocarbon spill preparedness and response measures in relation to the risk assessment and the identified hydrocarbon spill scenarios. A summary of Woodside's response arrangements in the Oil Pollution Emergency Plan (OPEP) is provided in **Section 8**.

7.1 Environment Plan Revisions and Management of Change

Revision of the WA-404-P Drilling EP will be undertaken in accordance with the requirements outlined in Regulations 17, Regulation 18 and Regulation 19 of the Environment Regulations. Woodside will submit a revision to the EP due to all or any of the following:

- When any significant modification or new stage of the activity that is not provided for in the WA-404-P Drilling EP;
- Before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental risk or impact not provided for in the WA-404-P Drilling EP;
- At least 14 days before the end of each period of 5 years commencing on the day on which the original and subsequent revisions of the EP is accepted under Regulation 11 of the Environment Regulations; and
- As requested by NOPSEMA.

Management of changes relevant to the WA-404-P Drilling EP, concerning the scope of the activity description including review of advances in technology at stages where new equipment may be selected such as vessel contracting, changes in understanding of the environment (including all current advice on species protected under EPBC Act and current requirements for Commonwealth Marine Reserves) and potential new advice from external stakeholders, will be managed in accordance with internal procedures for management of change. These provide guidance on the Environment Regulations that may trigger a revision and resubmission of the EP to NOPSEMA. They also provide guidance on what constitutes a significant new risk or increase in risk. A risk assessment will be conducted in accordance with Woodside's Environmental Risk Management Methodology to determine the significance of any potential new environmental impacts or risks not provided for in the WA-404-P Drilling EP. Risk assessment outcomes are reviewed in compliance with Regulation 17 of the Environment Regulations.

Minor changes where a review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a revision, under Regulation 17 of the Environment Regulations, will be considered a 'minor revision'. Minor administrative changes to the WA-404-P Drilling EP, where an assessment of the environmental risks and impacts is not required (e.g. document references, phone numbers, etc.), will also be considered a 'minor revision'. Minor revisions and administrative changes as defined above will be made to the WA-404-P Drilling EP using Woodside's document control process. Minor revisions will be tracked and incorporated during scheduled internal reviews.

8. OIL POLLUTION EMERGENCY RESPONSE ARRANGEMENTS

Woodside's OPEP for the Petroleum Activities Program has the following components:

- Oil Pollution Emergency Arrangements (Australia);
- WA-404-P Drilling Oil Pollution First Strike Plan; and
- Oil Spill Preparedness and Response Mitigation Assessment for WA-404-P Drilling Campaign.

8.1 Woodside Oil Pollution Emergency Arrangements (Australia)

This document outlines the emergency and crisis management incident command structure (ICS) and Woodside's response arrangements to competently respond to and escalate a hydrocarbon spill event. The document interfaces externally with Commonwealth, State and industry response plans and internally with Woodside's ICS.

Woodside's Oil Pollution Emergency Arrangements (Australia) details the following support arrangements:

- Access to MODU to drill intervention well via Memorandum of Understanding (MoU) with other industry participants;
- Master services agreement with Australian Marine Oil Spill Centre (AMOSC) for the supply of experienced personnel and equipment;
- Access to Wild Well Control's capping stack, SFRT equipment and experienced personnel for the rapid deployment and installation of a capping stack, where feasible (may require well intervention prior to deployment);
- Other support services such as 24/7 hydrocarbon spill trajectory modelling and satellite monitoring services as well as aerial, marine, logistics and waste management support; and
- Mutual Aid Agreements with other oil and gas operators in the region for the provision of assistance in a hydrocarbon spill response.

8.2 WA-404-P Drilling Oil Pollution First Strike Plan

The WA-404-P Oil Pollution First Strike Plan is an activity-specific document which provides details on the tasks required to mobilise a first strike response for the first 24 hours of a hydrocarbon spill event. These tasks include key response actions and regulatory notifications. The intent of the document is to provide immediate oil spill response guidance to the Incident Management Team until a full Incident Action Plan specific to the oil spill event is developed.

The activity vessels will have Ship Oil Pollution Emergency Plans (SOPEPs) in accordance with the requirements of International Convention for the Prevention of Pollution from Ships (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 WA-404-P Drilling Oil Pollution First Strike Plan is intended to work in conjunction with the SOPEPs.

Woodside's oil spill arrangements are tested by conducting periodic exercises. These exercises are conducted to test the response arrangements outlined in the WA-404-P Drilling Oil Pollution First Strike Plan and to ensure that personnel are familiar with spill response procedures, in particular, individual roles and responsibilities and reporting requirements.

8.3 Oil Spill Preparedness and Response Mitigation Assessment

Woodside has developed an oil spill preparedness and response position in order to demonstrate that risks and impacts associated with loss of hydrocarbons from the Petroleum Activities Program would be mitigated and managed to ALARP and would be of an acceptable level.

The following oil spill response strategies were evaluated and subsequently pre-selected for a significant oil spill event (level 2 or 3 under the National Plan) from the Petroleum Activities Program:

- Monitor and Evaluate (Operational Monitoring) – Operational Monitoring commences immediately following a spill and 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. Woodside would implement the following operational monitoring plans to satisfy the requirements of this strategy. The following operational monitoring programs are available for implementation:
  - Predictive modelling of hydrocarbons to assess resources at risk;
  - Surveillance and reconnaissance to detect hydrocarbons and resources at risk;
  - Monitoring of hydrocarbon presence, properties, behaviour and weathering in water;
  - Pre-emptive assessment of sensitive receptors at risk; and
  - Monitoring of contaminated resources and the effectiveness of response and clean-up operations.
- The following response strategies may be applied based on the outcomes of implemented Operational Monitoring programs:
  - Containment and recovery - The aim of this response strategy is to reduce damage to sensitive resources by the physical containment and mechanical removal of hydrocarbons from the marine environment.
  - Source control - A loss of well control is the identified worst case spill scenario. Woodside's primary mitigation strategy is to minimise the volume of hydrocarbons released. Woodside plans to deploy the following response options specific to a loss of well control event:
    - Well intervention - BOP intervention / ROV survey, Top kill / mud kill;
    - SFRT - Debris clearance/removal, Subsea dispersant injection;
    - Capping stack deployment; and/or
    - Relief well drilling.
  - Shoreline clean-up - Shoreline clean-up is undertaken when residual hydrocarbons not collected through previously described response strategies make contact with shorelines. The timing, location, and extent of shoreline clean-up can vary from one scenario to another, depending on the hydrocarbon type, shoreline type and access, degree of oiling and area oiled. A shoreline clean-up can limit injury to wildlife, prevent or reduce remobilisation of hydrocarbons in the tidal zone, facilitate habitat recovery and meet societal expectations.
  - Wildlife response - An oiled wildlife response would be undertaken in accordance with Woodside's Health, Safety, Environment and Quality Policy and values and recognition of societal expectations. The response would involve reconnaissance from vessels,

aircraft and shoreline surveys, the capture, transport, rehabilitation and release of oiled wildlife.

- Scientific monitoring - A scientific monitoring program (SMP) would be activated following a Level 2 or 3 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 ZoC and in particular, the identified Pre-emptive Baseline Areas (PBAs) in the event of a loss of well control from the PAP drilling activities (refer to response planning assumptions). The SMP would be informed by the operational monitoring programs, but differs from the operational monitoring program in being a long-term program independent of, and not directing, the operational oil spill response. Key objectives of the Woodside oil spill scientific monitoring program are:
  - Assess the extent, severity and persistence of the environmental impacts from the spill event; and
  - Monitor subsequent recovery of impacted key species, habitats and ecosystems.
- Waste management - Waste management is considered a support strategy to the response strategies examined above.

9. CONSULTATION

In support of the WA-404-P Drilling EP, Woodside conducted a stakeholder assessment and engaged with relevant stakeholders to inform decision-making and planning for continued production activities in accordance with the requirements of Regulation 11A and 14(9) of the Environment Regulations.

Woodside conducted a stakeholder assessment based on the activity location, timing and potential impacts. A consultation fact sheet was sent electronically to all stakeholders identified through the stakeholder assessment process prior to lodgement of the WA-404-P Drilling EP with NOPSEMA for assessment and acceptance. Woodside provided information about the Petroleum Activities Program to the relevant stakeholders listed in **Table 9-1**. Woodside considers relevant stakeholders for routine operations as those that undertake normal business or lifestyle activities in the vicinity of the existing facility (or their nominated representative) or have a State or Commonwealth regulatory role.

Table 9-1: Relevant stakeholders identified for the Petroleum Activities Program

Organisation	Relevance
Department of Industry, Innovation and Science	Department of relevant Commonwealth Minister
Department of Mines, Industry Regulation and Safety *(formally Department of Mines and Petroleum (WA DMP)*	Department of relevant State Minister
Australian Maritime Safety Authority (AMSA)	Maritime safety
Australian Hydrographic Service (AHS)	Maritime safety
Pearl Producers Association	Commercial fishery management
Department of Primary Industries and Regional Development (DPIRD) (Western Australia) *(formally Department of Fisheries)*	Commercial fishery management
Commonwealth Fisheries North West Slope Trawl Fishery Western Skipjack Fishery Western Tuna and Billfish Fishery Southern Bluefin Tuna Fishery Western Deepwater Trawl Fishery	Commercial fisheries – Commonwealth
Western Australian Fisheries Mackerel Fishery West Coast Deep Sea Crustacean Pearl Oyster	Commercial fisheries – State
Australian Maritime Safety Authority (AMSA) [2]	Oil spill preparedness (Australian waters) Marine pollution
Department of Transport	Oil Spill preparedness (WA waters)
Western Australian Fishing Industry Council (WAFIC)	Commercial fishery – State

[2] Woodside and AMSA have a Memorandum of Understanding whereby AMSA, as managers of the National Plan for Maritime Environmental Emergencies, will provide support to Woodside such as response equipment from national stockpiles (refer **Appendix D**). As such, advice about the proposed activities was provided to AMSA by way of an activity update email and provision of the first strike plan.

Department of Defence	Defence Estate Management
Australian Fishing Management Authority (AFMA)	Commonwealth fisheries
Commonwealth Fisheries Association	Commonwealth fisheries
Karratha Community Liaison Group (CLG)	Community liaison group
Neighbouring title holders	Chevron – permit operators of WA-53-R and WA-36-L
Dampier Port Authority	Relevant port

Woodside also made available advice about the Petroleum Activities Program to other stakeholders who may be interested in the activity or who have previously expressed an interest in being kept informed about Woodside's activities in the region. The following are stakeholders that have been identified as 'interested' in the Petroleum Activities Program:

- Australian Maritime Safety Authority (marine pollution);
- National Offshore Petroleum Titles Administrator (NOPTA);
- Department of Biodiversity, Conservation and Attractions (DBCA) (formerly Department of Parks and Wildlife);
- Australian Customs Service – Border Protection Command;
- Recfishwest;
- World Wildlife Fund (WWF);
- Australian Conservation Foundation;
- Wilderness Society;
- International Fund for Animal Welfare (IFAW);
- Australian Petroleum Production & Exploration Association (APPEA); and
- AMOSC - Oil spill preparedness Australian waters.

Woodside received feedback on the Petroleum Activities Program from a range of stakeholders, including government agencies and commercial fishing organisations. Woodside considered this feedback in its development of control measures specific to the Petroleum Activities Program. A summary of feedback and Woodside's response is presented in **Appendix C.**

9.1 Ongoing Consultation

Consultation activities for the Petroleum Activities Program build upon Woodside's extensive and ongoing stakeholder consultation for offshore petroleum activities in this area.

Feedback received through community engagement and consultation will be captured in Woodside's stakeholder database and actioned where appropriate through the Petroleum Activities Program Project Manager. Implementation of ongoing engagement and consultation activities for the Petroleum Activities Program will be undertaken by Woodside Corporate Affairs consistent with Woodside's External Stakeholder Engagement Operating Standard.

Woodside will continue to accept feedback from all stakeholders throughout the duration of the accepted WA-404-P Drilling EP. Stakeholder feedback should be made to the nominated liaison person, identified in **Section 10** of this EP Summary.

10. TITLEHOLDER NOMINATED LIAISON PERSON

For further information on this Petroleum Activities Program, please contact:

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11. ABBREVIATIONS AND ACRONYMS

Term	Description / Definition
µm	Micrometer
AHS	Australian Hydrographic Service
AHV	Anchor Handling Vehicle
ALARP	As Low as Reasonably Practicable
AMOSC	Australian Maritime Oil Spill Centre
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
BIA	Biologically Important Area
BOP	Blow-out Preventer
CAN	Conductor anchor node
CMR	Commonwealth Marine Reserve
DGPS	Differential Global Surface Position System
DP	Dynamically Positioned
EDS	Emergency Disconnect Sequence
ENVID	Environmental hazard Identification
Environment Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
EP	Environment Plan
ESD	Ecological Sustainable Development
EPBC Act	*Environment Protection and Biodiversity Conservation Act, 1999*.
FPSO	Floating Production, Storage and Offloading vessel
g/m^2	Grams per square metre
ICS	incident command structure
ISV	Installation Support Vessel
ITF	Indonesian Through Flow
IUCN	International Union for Conservation of Nature
KEF	Key Ecological Feature
km	Kilometre
L	Litres
LARS	Launch and Recovery System
MARPOL	International Convention for the Prevention of Pollution from Ships
MNES	Matters of National Environmental Significance
MODU	Mobile Offshore Drilling Unit
MoU	Memorandum of Understanding
MPA	Marine Protected Areas

nm	Nautical mile (1,852 m) a unit of distance on the sea
NOEC	No-observed-effect concentration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NTU	Nephelometric turbidity units
NWMR	North west marine region
NWS	Northwest Shelf
OCNS	Offshore Chemical Notification Scheme
OPEP	Oil Pollution Emergency Plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006*
PHG	Pre-hydrated Gum
ppb	Parts Per Billion
ppm	Parts Per Million
PTW	Permit to Work
RBA	Risk Based Analysis
ROV	Remotely Operated Vehicle
SCE	Solids Control Equipment
SMP	Scientific monitoring program
SOPEP	Ship Oil Pollution Emergency Plan
SVP	Senior Vice President
TD	Total Depth
TSS	Total Suspended Solids
SFRT	Subsea first response toolkit
VP	Vice President
WA	Western Australia
WAF	Water Accommodated Fractions
WAFIC	Western Australian Fishing Industry Council
WBM	Water Based Mud
WHA	World Heritage Area
WOMP	Well Operation Management Plan
Woodside	Woodside Energy Ltd
WWF	World Wildlife Fund
ZoC	Zone of Consequence

APPENDIX A: DETAILED ENVIRONMENTAL IMPACTS AND RISKS

PLANNED ACTIVITIES (ROUTINE AND NON-ROUTINE)

Physical Presence: Interference with or Displacement of Third Party Vessels

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Displacement of other users - proximity of MODU, ISVs and support vessels causing interference with or displacement to third party vessels (commercial fishing, recreational fishing and commercial shipping).							X	E	1	L
Wellhead left in-situ causing interference with or displacement to third party vessels (commercial shipping, and commercial/ recreational fishing).							X	E	1	L

Description of Source of Risk

In order to drill each well (up to six wells), the MODU will be present for approximately 90 to 120 days (includes mobilisation, demobilisation and contingency), with a further 25 days for well testing, at each well location, depending on operational requirements. Only one well will be drilled at time, therefore, a MODU may be present within the Permit Area for up to two and a half years (potentially spread out over the five-year approval period of the EP).

During Noblige-1 re-entry and plug/abandon activities, a MODU will be present at the well site for around 30 days. Support vessels will support the MODU. One vessel will be present within the vicinity of the MODU on standby at all times and the other/s will transit in and out of the Operational Area to port for emergency and routine operations. The support vessels will make approximately two to four trips per week.

An ISV may be used to install the CAN, should it be used as an alternative method of conductor installation. The CAN unit is pre-installed prior to the MODU arriving on location, and takes approx. two days to install. During that time the installation vessel remains under DP control, without anchoring. The CAN will be recovered with an ISV within +/- 6 months of the well finishing. The CAN is pumped out using an ROV. In the unlikely event that the CAN does not come out, it will be left on the bottom with the wellhead in situ. The removal of the CAN may take approximately three days.

The presence of the MODU, ISV and associated support vessel movements could present a navigational hazard to shipping and commercial fishing activities in the Operational Area.

On completion of a well, the wellhead assembly may be left in-situ, if routine removal techniques are unsuccessful. The wellhead left in-situ could potentially interfere with third party activities (in particular, fishing activities).

Impact Assessment

Potential Impacts to Socio-Economic Environment

Displacement to commercial fishing activities

A number of Commonwealth and State managed fisheries occur in the Permit Area. The proposed wells are situated within four Commonwealth and four State managed fisheries. However, only one fishery, the North West Slope Trawl fishery, is considered to be active in the vicinity of the Permit Area. The Permit Area is located in water depths ranging from approximately 1100 – 1600 m, which is outside the depth of range where typical fishing effort occurs, 350 – 600 m, and therefore, interactions with participants in the commercial fishery is unlikely. There was no direct response from licence holders during the consultation period with participants in this fishery.

Given the low level of fishing activity expected in the Permit Area, the presence of commercial fishing vessels in the Permit Area would likely be short term, potentially resulting in a minor interference (navigational hazard) and localised displacement/avoidance by commercial fishing vessels within the immediate vicinity of the MODU or ISV during CAN installation and removal (if required). However, there was no direct response from commercial fisheries during the stakeholder consultation period, and as such the potential impact is considered to be minor and temporary.

Potential impacts to commercial fishing in the event the wellhead remains in-situ are snag hazards of fishing equipment such as trawl nets that operate along the seabed. The one fishery considered active in the vicinity of the Permit Area, the North West Slope Trawl fishery, uses trawling practices; however, the fishery operates at depths between 350 and 600 m. Given the water depths in the Permit Area (1000 – 1600 m), impacts to the commercial fishing activities, if the wellheads remaining in-situ are considered highly unlikely.

Displacement of Recreational Fishing

Stakeholder consultation did not identify any key recreational fishing activity within the Permit Area. Recreational fishing in the region is concentrated around the coastal waters and islands of the NWMR such as the Montebello Islands (approximately 138 km from the Permit Area). Due to the distance offshore and water depths, recreational fishing is unlikely to occur in the Permit Area. In the event that recreational fishing effort occurred within the Operational Areas while drilling is being undertaken, displacement as a result of the Petroleum Activities Program would be minimal and relate only to the 500 m petroleum safety zone, around the MODU and the ISV during the CAN installation. Additionally, fishing activity may be excluded from the immediate area around the ISV during CAN installation (if required). Therefore, the potential impact is considered to slight and would be isolated to only short term impacts to reputation and brand.

Given the distance of the Permit Area offshore and water depths greater than 1000 m, snagging hazards to recreational fishing equipment as a result of the wellhead remaining in-situ are highly likely.

Displacement to Commercial Shipping

The presence of the MODU, ISV and support vessels could potentially cause temporary disruption to commercial shipping. The Permit Area lies beyond designated shipping fairways in the region and is not subject to significant commercial vessel traffic. A major route to and from the port of Fremantle lies approximately 40 km west and a minor connecting route passes approximately 40 km to the east of the Permit Area. During stakeholder consultation, AMSA noted that the MODU, ISV and support vessels are likely to encounter commercial shipping, based on historic vessel activity from March to May 2017. Consultation with AMSA has confirmed the Permit Area is subject to commercial shipping. The potential impacts associated with this Petroleum Activities Program include displacement of vessels as they make slight course alteration to avoid the MODU or ISV. Therefore, the potential impact is considered to be isolated and temporary.

Given the water depth of the proposed wells, impacts to commercial shipping as a result of the wellhead remaining in-situ are not considered credible.

Cumulative Impacts

There are no cumulative impacts from drilling activities, as no wells will be drilled concurrently. However, there may be cumulative impacts to commercial fisheries if multiple wellheads are left in situ. The one fishery considered active in the vicinity of the Permit Area, the North West Slope Trawl fishery, operates at depths found outside of the Permit Area (see above). Therefore, cumulative impacts if the wellheads remain in-situ are considered highly unlikely.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that physical presence of the MODU, ISV, support vessels and the potential presence of wellheads left in-situ (if required) will not result in a potential impact greater than slight, short term impact to shipping and commercial/recreational fishing interests (i.e. Reputation and Brand Impacts - E).

Summary of Controls

- Marine Orders 30 (Prevention of Collisions) 2009;
- Marine Order 21 (Safety of navigation and emergency procedures) 2012;
- No concurrent drilling permitted during the Petroleum Activities Program;
- Establishment of a 500 m petroleum safety zone around MODU and ISV (during CAN installation) and communicated to marine users;
- A support vessel is on standby during drilling activities to communicate with third-party vessels and assist in maintaining the petroleum safety zone;
- The support vessel will comply with the Woodside Marine Charterers Instructions to prevent unplanned interactions;
- Notify Australian Hydrographic Service (AHS) of activities and movements prior to the activities commencing;
- Notify Department of Primary Industries and Regional Development (Western Australia) (formally the WA Department of Fisheries) of activities;
- Notify AMSA JRCC of activities and movements;
- Undertake consultation with relevant stakeholders for activities and movements that commence more than a

year after EP acceptance; and

- Routine removal of the wellheads/CAN.

Physical Presence: Disturbance to Benthic Habitat from MODU Anchoring, Drilling Operations and ROV Operation

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Disturbance to seabed from drilling operations					X			F	1	L
Disturbance to seabed from installation of conductor with CAN (alternate method)					X			F	1	L
Disturbance to seabed from ROV operating operation (including localised sediment relocation from jetting activities)					X			F	1	L
Disturbance to seabed from MODU station holding (seabed transponders (DP MODU) or MODU mooring, including anchor holding testing)					X			E	1	L
Disturbance to seabed from wellhead remaining in-situ (if required)					X			F	1	L

Description of Source of Risk

Drilling

Drilling activities will result in direct seabed disturbance of up to 100 m radius around the well location due to the installation of the BOP and conductor. The generation and discharge of cuttings and drilling fluids are not considered in this section; refer to the separate risk assessment for an assessment of drill cuttings and drilling fluids.

Conductor installation with CAN

If a CAN unit is used to install the offline conductor, the suction process used will result in localised disturbance to the seabed and relocation of sediments surrounding the location of the well. The CAN unit is approximately 6 m diameter and 12-18 m in length and, if used, will discharge sediment to the seabed for only a short period while the top hole section of the well is installed and while the CAN is removed, both take approximately two days.

DP MODU Transponders

If a DP MODU is used, dynamic positioning of the MODU uses satellite navigation and radio transponders in conjunction with thrusters to maintain the position of the MODU at the required location. Information relating to the position of the MODU is provided via a number of seabed transponders, which are placed on the seabed and emit signals that are detected by receivers on the MODU and used to calculate position. The transponders are typically deployed in an array on the seabed, using clump weights comprising concrete, for the duration of the drilling at each well and at the end are recovered, generally by remotely operated vehicle (ROV). Clump weights are recovered if practicable to do so or may be left in situ on the seafloor. Clump weights generally consist of a clumped group of four 20 kg weights covering an area less than 1m2.

MODU Anchoring and Anchor Holding Testing

If a moored MODU is used, seabed disturbance will result from the anchor holding testing and MODU anchor mooring system, including placement of anchors and chain/wire on the seabed, potential dragging during tensioning and recovery of anchors. Overall, the mooring of the MODU and anchor holding testing activities will result in localised, small scale seabed disturbance in relation to the spatial extent of the benthic habitats. Mooring is likely to require a 12 point pre-laid mooring system at each well location. There are seven well locations for the Petroleum Activities Program, including six exploration and appraisal wells and the re-entry of Noblige-1 for the purpose of plugging and abandoning the well, equating to the need for approximately 84 anchor installations.

ROV

The use of the ROV during Petroleum Program Activities may result in temporary seabed disturbance and suspension of sediment causing increased turbidity as a result of working close to, or occasionally on, the seabed. ROV used close to or on the seabed is limited to that required for effective and safe subsea activities. The footprint of a typical ROV is approximately 2.5 m x 1.7 m. Additionally, the ROV may be used to relocate small amounts of sediment material (known as jetting) to create a stable, level surface and reduce the potential for scouring for subsea equipment (e.g. manifolds). This will cause localised and temporary impacts to water quality from increased turbidity and may cause localised and temporary impacts to benthic habitats.

Wellhead remains in-situ

Once drilling is complete, well infrastructure will be removed (except in the unlikely event where the routine wellhead removal techniques are unsuccessful). If the wellhead remains in situ there would be localised seabed disturbance around the wellhead location.

Impact Assessment

Potential Impacts to Ecosystems / Habitats

Deepwater Benthic Habitats

Drilling operations, the deployment, use of station holding system for a MODU (DP or anchored), anchor hold testing, CAN conductor installation and ROV operations are likely to result in localised physical modification to a small area of the seabed and disturbance to soft sediment. Bathymetry surveys indicate the seabed within the Permit Area is relatively flat and featureless, including the east and southeast regions of the Permit Area which overlap the Exmouth Plateau KEF. These areas of the Permit Area which overlap the Exmouth Plateau KEF are relatively flat on the surface of the Plateau, and then slope steeply down at the plateau edge to where the seabed flattens again into the deeper waters of the Montebello Trough. 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 and potential enhanced upwelling due to the Exmouth Plateau (may constitute unique environmental values, which is why the region has been classified as a KEF. Seabed disturbance is unlikely to influence upwelling and therefore not expected to impact on the ecological value of the Exmouth Plateau KEF. One percent of the Exmouth Plateau KEF overlaps the Permit Area.

The Permit Area, including the Exmouth Plateau, is expected to consist primarily of soft, fine unconsolidated sediments, which are typical of the broader NWP. Areas along the edge of the Exmouth Plateau likely consist of deep soft sediments travelling down the slope from shallower waters which have built up over the years from accumulation. Slumping of sediments off the Exmouth Plateau may result in the formation of valleys. As such physical impacts to the seabed are expected to be highly localised, non-significant disturbance to deepwater soft sediments with an absence of sensitive environmental receptors.

Due to the presence of soft sediments and lack of hard substrate, the seabed is likely to be inhabited by a low abundance of patchy distributions of filter feeders and other epifauna, including mobile epibenthos (e.g. sea cucumbers, ophiuroids, echinoderms, polychaetes and sea-pens, characteristic of the wider NWP. Impacts from drilling activities, including conductor installation, are expected to be confined to sediment burrowing infauna and surface epifauna invertebrates, particularly filter feeders, inhabiting the seabed directly around the well location, typically within 100 m of the well. Impacts to these broadly represented communities are expected to be highly localised with no significant impact to environment receptors.

ROV activities near the seafloor and small amounts of sediment relocation may result in slight and short-term impacts to deepwater biota, detailed above, as a result of elevated turbidity and the clogging of respiratory and feeding parts (turbidity) of filter feeding organisms. However, elevated turbidity would only be expected to be very short-term and temporary, and is therefore, not expected to have any significant impact to environment receptors, particularly given the low densities of benthic organisms in the deepwater environment of the Permit Area. If a CAN conductor is used, the suction process will also cause increased localised turbidity and sedimentation in close proximity to the well; however, impacts are still considered slight and temporary, as the conductor installation and removal will only require approximately two to three days.

In the unlikely event the wellhead cannot be removed, over time, the cement surrounding the wellhead will likely become buried in sediment as a result of prevailing ocean currents. Over time, the steel wellhead structure will corrode and marine fouling is expected to accumulate, whereby a marine life structure may remain above the seafloor. The wellhead remaining in-situ is expected to have a localised impact not significant to environment receptors. No further impacts to benthic habitats are likely.

Cumulative Impacts

Given the number of wells planned to be drilled during the Petroleum Activities Program, and 11 historically drilled wells, there is the potential for cumulative disturbance to the seabed and benthic communities. Cumulative seabed disturbance associated with the Petroleum Activities Program is expected to be restricted to an accumulation of disturbance areas from overlapping well footprints (in the event well locations are within hundreds of meters of each other).

The most recently drilled well existing within the Permit Area was plugged and abandoned approximately six years ago. It is expected that the benthic biological communities in these areas have fully recovered since then, therefore

posing no risk for cumulative impacts. Furthermore, as the nature of the activity (appraisal and exploration well drilling) is to characterise hydrocarbons within an area, the likelihood of wells being drilled in close proximity is low. Although the Permit Area is 1,388 km^2, the total area for all seven well Operational Areas is only 25% of this area. Given this, and the fact that benthic habitats within the Permit Area are well represented throughout the NWP and wider NWMR, cumulative impacts associated with seabed disturbance from overlapping well footprints are not expected to significantly increase the risk to benthic habitats present within the Permit Area.
Summary of Potential Impacts to Environmental Values(s)
Given the adopted controls, seabed disturbance from the petroleum activity program will result in localised, slight and short-term impacts to benthic habitat and communities (i.e. Environment Impact - E).
Summary of Control Measures
• WLSADS includes environmental sensitivity and seabed topography to inform the selection of the MODU mooring locations; and • Anchors installed as per mooring design analysis to ensure adequate MODU station holding capacity.

Routine Acoustic Emissions: Generation of Noise from VSP

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Generation of acoustic signals from VSP					X	X		F	2	L

Description of Source of Risk

Vertical Seismic Profiling (VSP) operations can generate noise that could exceed ambient noise levels generated by wind and wave action and biological noise (ambient noise levels range from around 90 dB re 1 µPa under very calm, low wind conditions, to 120 dB re 1µPa under windy conditions).

VSP is a standard method used during well logging. The duration of VSP is short, up to 24 hours for each of the wells (6 x 24 hours during the Petroleum Activities Program) and utilises relatively small airguns that generate impulsive low frequency noise.

The VSP source (typically 750 cui and comprising of 3 x 250 cui airguns) is expected to generate a peak pressure around 239 dB re 1 µPa @ 1 m, a sound pressure level (SPL) of 224 dB re 1 µPa^2 and sound exposure level (SEL) of 225 dB re 1 µPa^2.s @ 1 m with the majority of the noise concentrated at low (<100 Hz) frequencies.

Impact Assessment

Potential Impacts to protected species

In order to determine impacts to EPBC listed species an assessment was undertaken of the expected ranges of noise levels that could result in impacts. When acoustic waves propagate through water, there is a significant loss of intensity due to geometric spreading, reflection, absorption and scattering (International Association of Oil and Gas Producers, 2008). The sum of these losses is referred to as transmission loss. The short range spherical spreading loss component of this can be estimated to determine expected noise levels at short range using the spherical spreading loss calculation below:

$$\text{Transmission Loss (TL)} = 20 \log_{10}(r) + \alpha r$$

Where:

- *r* is the slant range between the source and the receiver
- α is the frequency dependent absorption coefficient for seawater (dependent on temperature, pH and salinity) calculated using the equation of Fisher and Simmons (1977); estimated to be 0.001 for typical seawater in the Permit Area. Note that for low frequency sound, such as VSP, the contribution of α to transmission loss is small compared to the geometric spreading term.

Based on this equation the expected range where noise levels will be equal to or greater than the relevant thresholds detailed in **Table 11-1**

Table 11-1: Noise level thresholds for cetaceans, marine turtles and whale sharks and expected distance from the source where noise levels will dissipate to below the relevant thresholds

Species Group	Threshold		Expected range of noise levels ≥ thresholds
Cetaceans	Permanent threshold shift	230 dB re 1 µPa OR 198 dB re 1 µPa^{2}s	~3 m ~23 m
	Behavioural Response	160 dB re 1 µPa^2	~1600 m
Marine Turtles	Permanent threshold shift	No data available	NA
	Behavioural Response	166 dB re 1 µPa^2	~800 m
Whale Sharks	Permanent threshold shift	>213 dB re 1 µPa OR >216 dB re 1 µPa^{2}s	~20 m OR ~3 m

	Behavioural Response	No data available	NA

Marine Fauna (Cetaceans)

Elevated underwater noise can affect marine fauna, such as whales, in three main ways:

- by causing direct physical effects on hearing or other organs (injury);
- by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey); and
- through disturbance leading to behavioural changes or displacement from important areas.

Available data on marine mammal behavioural responses to pulsed sounds are highly variable and context-specific. Recent studies on the behavioural response to humpback whales to seismic airguns has demonstrated behavioural response to seismic airguns above received sound exposure levels of 140 dB re 1 μPa^2.s (SEL). This study used the behavioural response of humpback whales to noise from two different moving air gun arrays (20 and 140 cubic inch air gun array) to determine whether a dose–response relationship existed. To do this, a measure of avoidance of the source was developed, and the magnitude (rather than probability) of this response was tested against dose. The proximity to the source, and the vessel itself, was included within the one-analysis model. Humpback whales were more likely to avoid the air gun arrays (but not the controls) within 3 km of the source at sound exposure levels over 140 dB re. 1 μPa^2 s−1, meaning that both the proximity and the received level were important factors and the relationship between dose (received level) and therefore the 140 dB re. 1 μPa^2 s−1 cannot be adopted as a stand-alone threshold if the source proximity is greater than 3 km. This study tested towing an airgun source directly into the incoming path of a southern humpback migration which included mother and calf humpback whales, therefore the context and applicability of these results may not be directly applicable to the behavioural response to all cetaceans in every context and has not been adopted for the assessment of potential behavioural impacts from VSP due to that fact that the source is stationary. It should be noted that Dunlop et. al. (2017) makes reference that their result is surprisingly consistent with previous studies with humpback whales in different behavioural contexts. For example, feeding humpback whales responded at ranges up to 3 km from the source, at levels of 150–169 dB re. 1 μPa and resting female humpback whales with calves displayed avoidance reactions at 140 dB re. 1 μPa, though other cohorts reacted at higher levels (157– 164 dB re. 1 μPa).

The United States (US) National Marine Fisheries Service guidance (2005) sets the Level B harassment threshold for marine mammals at 160 dB re 1 μPa (RMS) for impulsive noise. The value for impulsive sound sits in the upper-mid range for disturbance impacts identified in Southall et al. (2007) and in alignment with other studies; consequently, this criterion has been used (in lieu of more suitable up to date criteria) for assessing onset of potentially strong behavioural reaction in this assessment.

The relevant criteria proposed by Southall et al. (2007) for assessing the potential for permanent threshold shift due to multiple and single pulse sounds are considered to be an un-weighted peak pressure level of 230 dB re 1 μPa and an M-weighted SEL of 198 dB re 1 μPa^{2}s for all cetaceans. These injury criteria values are derived from values for onset of TTS with an additional allowance of +6 dB for peak sound and +15 dB for SEL to estimate the potential onset of PTS.

Marine Fauna (Fish and Marine Turtles)

There is a paucity of data regarding responses of marine turtles, whale sharks and rays to underwater noise. Popper et al. (2014) investigated, through a literature review, mortality, impairment and behaviour thresholds for fishes and found greater than 186 dB re 1 μPa^2 s was required to elicit even a temporary threshold shift (TTS) for fish (Table 11-2). Fishes have been shown to suffer auditory cell damage following exposure to high intensity noise; the noise level that induced damage in this experiment exceeded that of the VSP source to be used during the Petroleum Activities Program.

The Popper et al. (2014) review also assessed thresholds for marine turtles and found qualitative results that TTS was only high for near field exposure, while TTS was low for both intermediate and far field exposure. McCauley et al. (2000) noted that sea turtles exhibit increased swimming activity at 166 dB re 1 uPa^2.

Table 11-2: Threshold for seismic airguns (impulsive) exposure to fish and sea turtles (adopted from Popper et al. 2014)

Type of Animal	Impairment			Behaviour
	Recoverable Injury (PTS)	Temporary Threshold Shift (TTS)	Masking	
Fish 1 – no swim bladder (particle motion detector)	>216 dB re 1 μPa^2 s (cSEL) Or >213 dB re 1μPa	>186 dB re 1 μPa^2 s (cSEL)	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low

	(SPL peak)			
Fish 2 – Swim bladder is not involved in hearing (particle motion detector)	203 dB re 1 μPa^2 s (cSEL) Or > 207 dB re 1μPa (SPL peak)	>186 dB re 1 μPa^2 s (cSEL)	(N) Low (I) Low (F) Moderate	(N) High (I) Moderate (F) Low
Fish 3 – Swim bladder involved in hearing (primary pressure detection)	203 dB re 1 μPa^2 s (cSEL) Or >207 dB re 1μPa (SPL peak)	186 dB re 1 μPa^2 s (cSEL)	(N) Low (I) Low (F) Low	(N) High (I) High (F) Moderate
Sea turtles	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low

* *Relative risk: near (N), intermediate (I) and far (F)*

Impact to EPBC Listed Species

Controls including marine fauna observers will reduce potential impacts by allowing animals to move from the source of the sound to beyond the 1,600 m threshold zone (behavioural response for cetaceans). Any impacts to whale sharks, cetaceans and marine turtles is expected to be limited to short-term avoidance of a localised area with no long-terms impacts.

Seasonal Sensitivities of Marine Fauna

The use of VSP has the potential to cause temporary (up to approximately 24 hours for each well) and localised disturbance to marine fauna in response to received noise levels of 160 dB re 1 μPa (RMS). As the Petroleum Activities Program may take place at any time, VSP may overlap with the migration seasons for pygmy blue whales and whale sharks. It is possible that both species will occur, in small numbers, in the vicinity of the Permit Area at various times during the year, with increased numbers during peak periods. However, even with an increased likelihood of interaction the potential impacts are considered to be localised and not significant to environmental receptors (as described above).

It is reasonable to expect that cetaceans, whale sharks, rays and marine turtles may demonstrate avoidance or attraction behaviour in the vicinity of the VSP activity. However, any avoidance or attraction behaviours displayed by these transient animals resulting from the VSP activities are expected to be localised and temporary, based on the short duration of the VSP activities. Furthermore, VSP activities will be spread out sporadically for the seven wells. The intensity of noise dissipates with distance from its source. Based on the likely low abundance of MNES species in close proximity to the Permit Area and the properties of the noise emissions, it is considered not likely that there will be any significant impacts.

Other communities (zooplankton)

Zooplankton in the Permit Area is expected to be similar to offshore waters and include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Experiments by McCauley et al. (2017) indicated that seismic activity, based on the use of a 150 cui airgun, may significantly decrease abundance of some zooplankton (copepods, cladocerans and euphausiids larvae) and increase the mortality rate. However, zooplankton populations are expected to recover quickly due to their fast growth rates and the dispersal and mixing of zooplankton from outside the impacted area. Therefore, due to the short duration of the use of the VSP (up to approximately 24 hours for each well) and the expected recovery impacts are expected to be localised with no lasting effect.

Cumulative Impacts

There are no cumulative impacts, as no wells will be drilled concurrently.

Summary of Potential Impacts to environmental values(s)

VSP may be conducted for up to 24 hours during the Petroleum Activities Program (so potentially 6 x 24 hour periods spread out over the duration of the EP). Given the adopted controls, it is considered that VSP operations will not result in a potential impact greater than localised disruption with no lasting effect. (i.e. Environment Impact - F)

Summary of Controls

- VSP Operations in accordance with Woodside VSP Procedure;
- No prolonged exposure to whale sharks and turtles through application of pre-start visual observations,

operating procedures and low visibility operating procedures; and

- No concurrent drilling permitted during the Petroleum Activities Program.

Routine Acoustic Emissions: Generation of Noise from Activity Vessels, MODU, Positioning Equipment and Helicopter Transfers

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Generation of acoustic signals from drilling, support vessels and ISV during normal operations						X		F	1	L
Generation of acoustic signals from dynamic positioning systems on DP MODU						X		F	1	L
Generation of atmospheric noise from helicopter transfers						X		F	1	L

Description of Source of Risk

The MODU, ISV, support vessels and helicopters will generate noise both in the air and underwater, due to the operation of thrusters engines, propeller movement, drilling operations, etc. These noises will contribute to and can exceed ambient noise levels which range from around 90 dB re 1 μPa (root square mean sound pressure level (RMS SPL)) under very calm, low wind conditions, to 120 dB re 1μPa (RMS SPL) under windy conditions.

MODU Noise

Noise associated with a moored MODU will be restricted to drilling activities, such as drill pipe operations and on board machinery. A range of broadband values (59 to 185 dB re 1 μPa at 1 m (RMS SPL)) have been quoted for various MODUs, where noise is likely to be between 100 to 190 dB re 1 μPa at 1 m (RMS SPL) during drilling and between 85 to 135dBre 1 μPa at 1 m (RMS SPL) when not actively drilling. McCauley (1998) recorded received noise levels approximately 117 dB re 1 μPa at 1 m (RMS SPL) at 125 m from a moored MODU whilst actively drilling (with support vessel on anchor).

DP MODU underwater noise measurements were taken for the Maersk Discoverer drill rig used on the North West Shelf (NWS) showed the system emitted tonal signals between 200 Hz and 1.2 kHz, which is within the auditory bandwidth of cetaceans. The measured source level was between 176 and 185 dB re 1μPa at 1 m. A noise assessment for the Deepwater Millennium estimated the broadband source level for drilling operations at 196 dB re 1μPa at 1 m, with all six thrusters working at 100%, which is a worst case scenario, as standard operation uses thrusters at 60% capacity or less depending on weather conditions. The DP MODU will maintain DP for the active drilling period.

The MODU is expected to be on location for up to 90 to 120 days for each exploration / appraisal well, over a five year period. The re-entry and plug and abandonment of the Noblige-1 well is expected to require the MODU on location for 30 days.

ISV and Support Vessel Noise

The main source of noise from a DP vessel (such as ISVs) relates to the use of DP thrusters. There is no applicable sound data available for a typical DP ISV; however, frequencies and sound levels are expected to be similar to those from a DP drill ships (e.g. MODU) detailed above. The 196 dB re 1μPa at 1 m, estimated above is expected to be worst case as the ISV is not expected to operate on 100% DP capacity on a continual basis.

Support vessels will maintain DP while the vessel is maintaining position. McCauley (1998) measured underwater broadband noise equivalent to approximately 182 dB re 1 μPa at 1 m (RMS SPL) from an support vessel holding station in the Timor Sea; it is expected that similar noise levels will be generated by support vessels used for this

Petroleum Activities Program.

Note that all support vessels are required to comply with EPBC Regulation 2000 – Part 8 Interacting with Cetaceans to reduce the likelihood of collisions with cetaceans. Implementing this control may incidentally reduce the noise generated by vessels in proximity to cetaceans as vessels will be travelling slower; slower vessel speeds may reduce underwater noise from machinery noise (main engines) and propeller cavitation.

Generation of noise from helicopter transfers

Helicopter engines and rotor blades are recognised as a source of noise emissions, which may constitute a source of environmental risk resulting in behavioural disturbance to marine fauna. Activities relevant to the Permit Area will relate to the landing and take-off of helicopters on the MODU or vessel helidecks. Helicopter flights are at their lowest (i.e. closest point to the sea surface) during these periods of take-off and landing from helidecks, which constitutes a relatively short phase of routine flight operations. During these critical stages of helicopter operations, safety takes precedence.

Noise levels for typical helicopters used in offshore operations (Eurocopter Super Puma AS332) at 150 m separation distance have been measured at up to a maximum of 90.6 dB. Unconstrained point source noise in the atmosphere (such as helicopter noise) spreads spherically, with noise received at the sea surface decreasing with increasing distance from the aircraft. Based on spherical geometric spreading (and not considering transmission loss from atmospheric absorption), the sound level is expected to decrease by 6 dB for every doubling of the distance from the source. Using this model, a maximum sound level of approximately 90 dB at 150 m would be reduced to approximate 76 dB directly below a helicopter travelling at an altitude of 500 m.

Generation of underwater noise from positioning equipment

Transponders may be placed on the seabed to assist the DP MODU maintain the correct position. Transponders typically emit high frequency noise, above 10kHz. An example transponder, the Kongsberg Multifunction Positioning Transponder 163 series, is expected to generate a peak pressure around 186 to 198 dB re 1 µPa @ 1 m.

Impact Assessment

Potential Impacts to Protected Species

The Permit Area is located in waters approximately 1,100 to 1,600 m deep. The fauna associated with this area will be predominantly pelagic species of fish, with migratory species such as turtles, whale sharks and cetaceans present in the area seasonally.

Elevated underwater noise can affect marine fauna, including cetaceans, fish, turtles, sharks and rays in three main ways:

(1) by causing direct physical effects on hearing or other organs (injury)

(2) by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)

(3) through disturbance leading to behavioural changes or displacement from important areas.

The thresholds that could result in behavioural response for cetaceans is expected to be 120 dB re 1 µPa[2] for continuous noise sources, and 160 dB re 1 µPa (RMS) for impulsive noise sources. These thresholds are adopted by the United States National Oceanic and Atmospheric Administration (NOAA) and are consistent with the levels presented by Southall *et al.* (2007). More permanent injury would be expected to occur at 230 dB re 1 µPa (peak). Noise generated by a DP MODU, ISV or support vessels to be used for this Petroleum Activities Program does not exceed that level so permanent injury to protected species is not anticipated.

Listed threatened and listed migratory species that could be potentially impacted by noise and vibration may be present within the Permit Areas and primarily include cetaceans as well as whale sharks, rays and turtles. The Permit Area overlaps the migration BIA for pygmy blue whales, which are seasonally present in the area from April to August (northbound) and October to December (southbound).

MODU, ISV and Support Vessels

It is likely that there may be increased numbers of individuals of pygmy blue whales within the Permit Area during the seasonal periods described above. However, even with an increased likelihood of interaction the potential impacts are considered to be not significant to environmental receptors given the noise levels associated with routine operations of vessels and the MODU. It is reasonable to expect that fauna may demonstrate avoidance or attraction behaviour to the noise generated by the Petroleum Activities Program. For example, when transiting through the area, pygmy blue whales may deviate slightly from their migration route, but continue on their migration pathway. Note that the Permit Area is surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal's ability to avoid the activities. Additionally, only one well will be drilled at a time, therefore, multiple petroleum activities which may impede migration routes further, will not occur. Predicted noise levels from the MODU, ISV and support vessels are not considered to be ecologically significant at a population level.

Other fauna associated with the Permit Area will be predominantly pelagic species of fish with migratory species such as whale sharks, rays, marine turtles and other cetacean species transiting through the Permit Area. Therefore, potential impacts from vessel noise are likely to be restricted to temporary avoidance behaviour to individuals transiting through the Permit Area, and are therefore, considered localised with no lasting effect. As the wells will not be drilled concurrently there is no potential for cumulative impacts from drilling concurrent wells.

Helicopter Noise

Water has a very high acoustic impedance contrast compared to air, and the sea surface is a strong reflector of noise energy (i.e. very little noise energy generated above the sea surface crosses into and propagates below the sea surface (and vice versa) – the majority of the noise energy is reflected). The angle at which the sound path meets the surface influences the transmission of noise energy from the atmosphere through the sea surface; angles ±>13° from vertical being almost entirely reflected. Given this, and the typical characteristics of helicopter flights within the Permit Area (duration, frequency, altitude and air speed), the opportunity for underwater noise levels that may result in behavioural disturbance are not considered to be credible. Note that helicopter noise during approach, landing and take-off is more likely to propagate through the sea surface due to the reduced air speed and lower altitude. However, helicopter noise during approach, landing and take-off will be mingled with underwater noise generated by the facility hosting the helipad (e.g. thruster noise from vessels, machinery noise from MODU etc.). Additionally, approach, landing and take-off are relatively short phases of the flight, resulting in little opportunity for underwater noise to be generated.

Given the standard flight profile of a helicopter transfer, maintenance of a >500 m horizontal separation from cetaceans (as per the EPBC Regulations), and the predominantly seasonal presence of whales within the Permit Area, interactions between helicopters and cetaceans resulting in behavioural impacts are considered to be highly unlikely. In the highly unlikely event that cetaceans are disturbed by helicopters, responses are expected to consist of short-term behavioural responses, such as increased swimming speed; the consequence of such disturbance is considered to have no lasting effect and of no significance.

Turtles may be present in low numbers within the Permit Area, and may be exposed to helicopter noise when on the sea surface (e.g. when basking or breathing). Typical startle responses occur at relatively short ranges (10's of metres) and as such, startle responses during typical helicopter flight profiles are considered to be remote. In the event of a behavioural response to the presence of a helicopter, turtles are expected to exhibit diving behaviour, which is of no lasting effect.

Seabirds with the Permit Area may avoid helicopter flights. Given the expected low density of seabirds within the Permit Area, the relative infrequency of helicopter flights and lack of lasting effect of potential behavioural responses to helicopter noise, the likelihood and consequence of subsequent impacts are considered to be highly unlikely and result in no lasting effect, respectively.

Positioning Equipment Noise

Due to the short duration of use and higher frequencies used by positioning equipment, the acoustic noise from the transponders is unlikely to have an effect on the behavioural patterns of marine fauna. Therefore, no impacts are anticipated from positioning transponders.

Summary of Potential Impacts to environmental values(s)

It is considered that noise generated by ISV, support vessels, MODU drilling activities, helicopters and positioning transponders will not result in a potential impact greater than localised impacts with no lasting effect, not significant to marine fauna. (i.e. Environment Impact - F)

Summary of Control Measures

- The potential impacts and risks from routine noise emissions (excluding VSP) are deemed to be ALARP in its current risk state. No reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice.

Routine and Non-routine Discharges to the Marine Environment: MODU and Project Vessels

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Routine discharge of sewage, grey water and putrescible wastes to marine environment from MODU, ISV and support vessels			X					F	2	L
Routine discharge of deck and bilge water to marine environment from MODU, ISV and support vessels			X					F	2	L
Routine discharge of cooling water or brine to the marine environment from MODU, ISV and support vessels			X					F	2	L

Description of Source of Risk

The MODU, ISV and support vessels routinely generate/discharge the following:

- small volumes (impact assessment based on approximate discharge of 250 m^3 per vessel / MODU per day) of treated sewage and putrescible wastes to the marine environment;
- routine/periodic discharge of relatively small volumes of bilge water. Bilge tanks receive fluids from many parts of the support vessel, ISV or MODU. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals;
- variable water discharge from MODU/vessel decks directly overboard or via deck drainage systems. Water sources could include rainfall events and/or from deck activities such as cleaning/wash-down of equipment/decks; and
- Cooling water from machinery engines or mud cooling units and brine water produced during the desalination process of reverse osmosis to produce potable water on board the support vessels, ISV and MODU.

Environmental risk relating to the disposal/discharges above regulated levels or incorrect disposal/discharge of waste would be unplanned (non-routine/accidental) and are addressed in the unplanned risk assessments.

Impact Assessment

Potential Impacts to water quality and marine fauna

The main environmental impact associated with ocean disposal of sewage and other organic wastes (i.e. putrescible waste) is eutrophication. Eutrophication occurs when the addition of nutrients, such as nitrates and phosphates, causes adverse changes to the ecosystem, such as oxygen depletion and phytoplankton blooms. Other contaminants of concern occurring in these discharges may include ammonia, *E. coli*, faecal coliform, volatile and semi-volatile organic compounds, phenol, hydrogen sulphide, metals, surfactants, and phthalates.

Woodside conducted monitoring of sewage discharges at their Torosa-4 Appraisal Drilling campaign which demonstrated that a 10 m^3 sewage discharge reduced to approximately 1% of its original concentration within 50 m of the discharge location. In addition to this, monitoring at distances 50, 100 and 200 m downstream of the platform and at five different water depths confirmed that discharges were rapidly diluted and no elevations in water quality monitoring parameters (e.g. TN, total phosphorous and selected metals) were recorded above background levels at any station. Mixing and dispersion would be further facilitated in deep offshore waters, consistent with the location of the Permit Area, through regional wind and large scale current patterns resulting in the rapid mixing of surface and near surface waters where sewage discharges may occur. Studies investigating the effects of nutrient enrichment from offshore sewage discharges indicate that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed areas.

Furthermore, open marine waters do not typically support areas of increased ecological sensitivity, due to the lack of nutrients in the upper water column and lack of light penetration at depth. Therefore, presence of other receptors such as fish, reptiles, birds and cetaceans in significant numbers, and in close proximity to the Permit Area, is unlikely. Research also suggests that zooplankton composition and distribution are not affected in areas associated with sewage dumping grounds. Plankton communities are expected to rapidly recover from any such short-term, localised impact, as they are known to have naturally high levels of natural mortality and a rapid replacement rate. Additional discharges outlined which may include other non-organic contaminants (e.g. bilge water), will be rapidly diluted through the same mechanisms as above and are expected to be in very small quantities and concentrations as to not pose any significant risk to any relevant receptors. No significant impacts from the planned (routine and non-routine) discharges that are listed above are anticipated because of the minor quantities involved, the expected localised mixing zone and high level of dilution into the open water marine environment of the Permit Area. The Permit Area is located more than 12 nm from land, which exceeds the exclusion zones required by Marine Order 96 (Marine pollution prevention – sewage) 2013 and Marine Order 95 (Marine pollution prevention – garbage) 2013. Whilst the Petroleum Activities Program may extend for several years, vessels will not be continuously in the Permit Area during this time, vessels will also be moving (i.e. not in a single location for an extended period of time (i.e. max time of MODU 90-120 days). Rather, these routine and non-routine discharges are expected to be intermittent in nature for the duration of the Petroleum Activities Program. Therefore, cumulative impacts to water quality within the Permit Area are expected to be localised and short-term with no lasting effect. It is possible that marine fauna transiting the localised area may come into contact with these discharges (e.g. pygmy blue whales as they traverse the Permit Area during their seasonal migrations, however, given the localised extent of cumulative impacts from multiple vessel discharges within the Permit Area, significant impacts to marine fauna are not expected.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that routine or non-routine discharges described will not result in a potential impact greater than localised contamination not significant to environmental receptors, with no lasting effect. (i.e. Environment Impact - F)
Summary of Control Measures
• Marine Orders 95 – pollution prevention – Garbage (as appropriate to vessel class); • Marine Orders 96 - pollution prevention – sewage (as appropriate to vessel class); • Woodside Engineering Standard for Rig Equipment specifies requirements for deck drainage and management of oily water for MODU; and • Marine Orders 91 – oil (as relevant to vessel class) requirements which include mandatory measures for the processing of oily water prior to discharge.

Routine and Non-routine Discharges to the Marine Environment: Drill Cuttings and Drilling Fluids (WBM)

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Routine discharge of WBM drill cuttings to the seabed and the marine environment		X	X		X			E	1	L
Routine discharge of drilling muds (WBM) to the seabed and the marine environment.		X	X		X			E	1	L
Non-routine discharge of wash water from mud pits		X	X		X			E	1	L
Routine discharge of well clean-up and DST fluids		X	X					E	1	L
Discharge of well annular fluids from abandoned well		X	X		X			F	1	L

Description of Source of Risk

Drilling Program

The proposed Petroleum Activities Program includes the drilling of up to six wells (three appraisal and three exploration) and the re-entry and plugging and abandoning of one well (Noblige-1), all at a seabed depth ranging from approximately 1,100 – 1,600 m.

The location of one of the wells - 'Ferrand', an exploration well, has been confirmed. The 'Ferrand' well has a TD of approximately 5,200 m total vertical depth subsea (TVDSS). The other wells which may be drilled will not exceed the expected depth of Ferrand, therefore the volumes of drill cuttings and muds for Ferrand is considered worst case and will be used to represent the other five wells that may be drilled.

The following describes the source of risk with respect to discharge of drill cuttings, mud and clean-up fluids only (see the detailed risk assessment summary for cement, cementing fluids and subsea control fluids) from the worst case 'Ferrand' well scenario. The base case (e.g. typical drilling operations) for the management of cuttings is to discharge into the marine environment along with WBM drilling muds which are used to transport the cuttings out of the well.

For the purposes of this risk assessment, the indicative dimensions, discharge locations and approximate cuttings volumes provided in **Table 11-3** represent the worst case well, Ferrand, to be drilled during the Petroleum Activities Program.

Wells will be drilled as a series of sections, as detailed in **Table 11-3**. The top hole sections of each well will be drilled without a riser in place (i.e. riserless drilling). Upon drilling of the top hole sections, casings will be cemented in place, a BOP installed and a riser put in place between the BOP and the MODU. The riser remains in place during drilling of the bottom hole sections and facilitates the circulation of drilling fluids and cuttings between the well bore and the MODU. In the scenario of the re-entry and plug and abandonment of Noblige-1, a BOP will also be installed and cuttings will be discharged in the same manner as conventional cuttings.

Table 11-3: Estimated discharges of cuttings and volumes of drilling fluids used for the Petroleum Activities Program[3]

Well Section	Section width (inches)	Cuttings volume (m^3)	Drilling Fluid Type and ~ volume (m^3)	Hole section	Discharge Point
36" Conductor	42	85	Seawater/gel sweeps- 160	Top	Seabed
Alternative to 36"	06 meters	0 to 10	No fluids pumped, Suction	Top	Seabed

[3] *Volumes described are approximate.*

Conductor: CAN-ductor			process utilized.		
22" Surface Casing	26	510	Seawater/gel sweeps, PAD mud- 3180	Top	Seabed
18" Liner	22	103	WBM - 795	Bottom	Below Surface
13-5/8" Casing	16.5	190	WBM - 318	Bottom	Below Surface
11-3/4" Liner	14.75	70	WBM- 238	Bottom	Below Surface
9-5/8" Liner	12.25	48	WBM 238	Bottom	Below Surface
Riser Volume	-	-	WBM- 287	Bottom	Below Surface
Active and Reserve Pit	-	856	WBM - 763	Bottom	Below Surface
	Total Planned Activities	1,006	5,979		
Contingent Activities (Top hole respud x 2)	42" + 26" Section	1190	Seawater/gel sweeps, PAD mud- 6680	Top	Seabed
Contingent Activities (Sidetrack 1 section)	17-1/2" Section	293	WBM - 1115	Bottom	Below Surface

Drill Cuttings

Indicative drill cuttings generated from drilling the Ferrand well have been estimated to comprise a total of approximately 1066 m^3. Typically, drilling generates drill cuttings ranging in size from very fine (0.016 mm) to very coarse (<1 cm) particle/sediment sizes, determined by TD, lithology, drill bit employed and SCE specifications. Indicative volumes of drill cuttings for the well are outlined in **Table 11-3**.

Cuttings resulting from drilling the top hole section are drilled using a seawater, pre-hydrated bentonite sweeps drilling fluid (WBM) system, discharging the cuttings to the seabed at the well site where they will accumulate near the wellhead. If a CAN is used in place of the 36" conductor, cuttings from this section will be negligible, with some sediment discharges made associated with the material displaced by the CAN as it is installed via 'suction'.

The bottom hole sections will be drilled with a marine riser that enables cuttings and drilling fluid to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the Solid Control Equipment (SCE). The SCE uses shale shakers to remove coarse cuttings from the drilling fluids. After processing by the shale shakers, the recovered fluids from the cuttings may be directed to centrifuges, which are used to remove fine solids (~4.5 to 6 µm). The cuttings with retained fluids are discharged below the water line and the mud is recirculated into the fluid system. Cuttings will typically drop out of suspension in the vicinity of the well site (as coarser materials), while the fluids, if not flocculated with the cuttings may disperse further, temporarily elevating TSS and sediment deposition.

DST and Well Bore Clean-Out Fluids

Prior to installing the DST string wells will generally be displaced from the drilling fluid system to brine. A chemical cleanout fluids train will be circulated between the two fluids, then seawater or brine circulated until operational cleanliness specifications are met. This will be in line with Woodside's Reservoir, Drilling and Completions Fluids Guideline DC0000PD1400116213. Brine is this typically a filtered brine with <70 NTU and/or <0.05% total suspended solids (TSS). This results in a brine and seawater discharge after this operation. Should there be clean-up brine contaminated with base oil, it will be captured and stored on the MODU for processing prior to discharge, or returned to shore if treatment/processing is not possible. For initial clean-up fluids (usually returned to the rig within the first few hours of circulation) which are predominantly drilling mud (concentration of mud compared to brine is a higher percentage of mud); WBM will be discharged as per requirements in the EP.

Cement cuttings when drilling through existing cement plugs

Potential cuttings associated with the re-entry and plugging and abandoning of Noblige-1 are limited to approximately 8 m^3 (total volume) of cement if drilling through existing plugs is found necessary. As a result, the potential volume of cuttings for Noblige-1 will be far less than cutting from other wells; however, will consist of hardened cement rather than subsea rock and sediment. Impacts from these cuttings are expected to be consistent with those from the other six exploration and appraisal wells and, therefore, are also considered to be represented by the worst case Ferrand scenario.

Drilling Muds

WBM will be operationally discharged to the marine environment at the location of the well being drilled during the Petroleum Activities Program under the following scenarios:

1. at the seabed when drilling the top hole (riser less) sections

2. below sea surface as fluid remaining on drill cuttings, after passing through the SCE (bottom hole sections, drilled with riser in place)
3. from the mud pits from a pipe below the sea surface, if the WBM cannot be re-circulated/ re-used through the drilling fluid system (due to deterioration/ contamination), re-used on the well or on another well; or stored.

WBM drilling fluids are contained within the drilling fluids circulation system. Mud pits (tanks) within this system provide capacity for the storage of drilling fluids. The mud pits are cleaned out at the completion of drilling operations. Mud pit residue may be discharged to the sea where the residue contains <1% oil volume. Where the mud pit residue exceeds 1% by volume, the residue will either be retained or disposed of onshore. While no NWBM will be used during the Petroleum Activities Program, contamination of mud pits may come from the use of base oil during inflow testing prior to well abandonment. Base oil and chemicals used in WBM are assessed in accordance with Woodside *Chemical Selection and Assessment Environment Guideline.*

Contingent Activities

Respud

The requirement to respud a well is overall a low likelihood event. If required, the most likely scenario is that the decision to respud is made during drilling of the top hole section of a well, and therefore the incremental increase in cuttings and mud discharges are associated with the repeat drilling of the same top hole sections for the respudded well with the same associated discharges. A respud once drilling of the bottom hole sections has commenced is far less likely given the time and effort already committed to the well. However, if this was to occur the associated discharges would also be a repeat of the discharges as per **Table 11-3** to re-drill the same sections of the respudded well. The likelihood of respudding an exploration/appraisal well is unlikely (<10% probability).

Sidetrack

There is no allowance for sidetracking of exploration and appraisal wells as it's a low probability therefore it's not planned and drill cuttings volumes are not known. It is expected that any additional drill cuttings would be within the volumes detailed in **Table 11-3**.

Well annular fluids

Following completion of drilling, some wellbore fluids will remain in the annular spaces between casing. Upon wellhead removal, small volumes (~ 1.5 m^3) of fluid exchange between the annular spaces and the ocean may occur. The exchange will not be instantaneous as the annular spaces are small and the fluids are typically heavier than seawater. In the unlikely event routine wellhead removal techniques are unsuccessful, this fluid exchange will happen following sufficient corrosion of the wellhead.

Impact Assessment

Potential Impacts to water quality, marine sediment quality and habitats and communities

The identified potential impacts associated with the discharge of drill cuttings and fluids include a localised reduction in water and seabed sediment quality, and detrimental but localised changes to benthic biota (habitats and communities).

A number of direct and indirect 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.

The six wells will be drilled in the Permit Area situated in offshore waters (~260 km from mainland Western Australia) in the deep ocean aphotic bathypelagic zone (water depths of ~1,100 – 1,600 m). The Montebello Commonwealth Marine Reserve is the closest MPA to the Permit Area, at a distance of approximately 89 km (south south-east). The abiotic habitat in the area is likely comprised of deep soft, unconsolidated sediment seabed, which is relatively flat and featureless.

The Exmouth Plateau KEF overlaps the Permit Area at its south and south-west boarders. Areas of the Exmouth Plateau overlapping the Permit Area are likely to consist of mainly deep soft sediments, particularly near the plateau edges from sediment transport and accumulation. As the Permit Area is located in deep waters of the aphotic bathypelagic zone, the seabed habitat likely supports low abundance and diversity benthic communities comprised of patchy distributions of filter feeders and other epifauna, including mobile epibenthos (e.g. sea cucumbers, ophiuroids, echinoderms, polychaetes and sea-pens, consistent with the NWP.

The top hole sections drilled (riser-less) have drill cuttings and unrecoverable fluids discharged at the seabed at the well site and typically result in a localised area of sediment deposition (known as a cuttings pile) in close proximity to the well site. Depending on seabed current regimes, a greater spread of cuttings and WBMs may occur downstream from the well site. The bottom hole sections are drilled after the riser is fitted. Cuttings with unrecoverable fluids are discharged below the water line at the MODU site, resulting in drill cuttings and drilling fluids rapidly diluting, which disperse and settle through the water column. The dispersion and fate of the cuttings is determined by particle size and density of the unrecoverable fluids, therefore, the sediment particles will primarily settle in proximity to the well site with potential for localised spread downstream (depending on currents and their speed throughout the water column and seabed). The finer particles will remain in suspension and be transported further before settling. Top hole cuttings are highly localised and concentrated around the wellhead, while research has shown that volumes of bottom hole cuttings sharply decrease with distance from the discharge point; however the distribution of these cuttings is generally very patchy.

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 (mainly top hole cuttings), smothering effects from raised sedimentation concentrations as a result of elevated Total Suspended Solids (TSS), changes to the physio-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 for bottom hole cuttings are generally confined to a maximum of 500 m of the discharge point, while cuttings for top hole drilling will be much more localised. Should a CAN conductor be used, cuttings from top hole drilling will be more widely distributed, but will still be within the impact zone of 500 m from bottom hole cuttings.

Habitats and Communities (physical impact of cuttings)

Cuttings discharged at the seabed during drilling of the top hole sections of wells will result in localised cuttings piles on the seabed surrounding the well head. Benthic organisms below this cuttings pile will be smothered; however, the cuttings piles from top hole sections are expected to be recolonised over time. Drilling fluids used for the top hole sections consist entirely of WBM. Mobile benthic fauna, such as demersal fish, may be temporarily displaced from areas where cuttings discharges accumulate. Ecological impacts are expected to such biota is predicted when sediment deposition is equal to or greater than 6.5 mm (in thickness). This amount of sediment deposition is expected to be confined to within a few hundred metres around the well location. Low levels of sediment deposition away from the immediate area of the well site may occur and would represent a thin layer of settled drill cuttings which will likely be naturally reworked into surface sediment layers through bioturbation and will not be of a significant impact.

Furthermore, ecological impacts are not expected for mobile benthic fauna such as crabs and shrimps or pelagic and demersal fish given their mobility (IOGP, 2016). Balcom *et al*. (2012) concluded that impacts associated with the discharge of cuttings and base fluids are minimal, with impacts highly localised to the area of the discharge. Changes to benthic communities are normally not severe. Organic enrichment can occur leading to anoxic conditions in the surface sediments and a loss of infauna species that have a low tolerance to low oxygen concentrations, and to a lesser extent chemical toxicity near the well location. These impacts are highly localised with short-term recovery that may include changes in community composition with the replacement of infauna species that are hypoxia-tolerant. Recovery of affected benthic infauna, epifauna and demersal communities is expected to occur quickly, given the short duration of sediment deposition and the widely represented benthic and demersal community composition.

Water Quality

The discharge of drill cuttings and unrecoverable fluids is expected to increase turbidity and total suspended sediment 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. Drill cuttings discharge is generally intermittent and of short duration (over a total period of approximately 75 days) during the drilling of a well. Nelson *et al.* (2016) identified <10 mg/L as no effect or sub lethal minimal effect concentration. Given the generally low concentration of total suspended solids (TSS) (due to rapid dispersion from the well site), the offshore open ocean site in conjunction with rapid dispersion of sediment and the short period of intermittent discharge, the plume is not expected to have more than a very highly localised potential area of ecological impact and it is not predicted to impact productivity of the water column. Furthermore, there are no likely impacts expected for pelagic fauna. While very high concentrations of suspended sediments have been shown to result in mortality of pelagic animals (>1830 mg/L), such concentrations do not occur as a result of drill cuttings discharges. In addition, fish are likely to move away when elevated TSS concentrations are detected while air breathing megafauna such as cetaceans and turtles are not expected to be in direct contact with TSS plume given its proximity to the MODU. Any potential contact would be of a short duration given the rapid dispersion of the plume and the expected transient movement of megafauna in this offshore area. Light dependent benthic primary producer habitats are not located with the Permit Area.

Given the composition and wider representation of the expected benthic communities in the vicinity of the Permit Area, the ecological impacts are considered to be slight and short-term.

Drill cuttings discharged at the seabed and settlement of cuttings may, depending on final location of wells, occur on the Exmouth Plateau KEF. Given the benthic habitats characteristic of the KEF, likely soft sediment with associated infauna, and the wider representation of the KEF (~99%) outside of the Permit Area, any potential ecological impacts will be localised and are not considered significant. Additionally, the values of the Exmouth Plateau KEF (e.g. enhanced upwelling) will not be impacted by the settlement of cuttings on the Plateau.

Sediment Quality and Habitats and Communities (contamination from and toxicological effects of drilling muds)

Indicative components of the WBM system have a low toxicity. Bentonite and a chemical from the family of XC Polymer's (Xanthan Gum or similar) are listed as 'E' category fluids under the OCNS and considered to 'pose little or no risk to the environment' (PLONOR). These metals are present primarily as insoluble mineralised salts and consequently are not released in significant amounts to the pore water of marine sediments and have low bioavailability to those benthic fauna which may come into contact with the discharged barite.

The XC Polymer and bentonite sweeps have very low toxicities and are considered by OSPAR to be PLONOR to the environment. They may; however, cause physical damage to benthic organisms by abrasion or clogging, or through changes in sediment texture that can inhibit the settlement of planktonic polychaete and mollusc larvae (Swan et al., 1994). However, these impacts are not expected to be significant due to the rapid biodegradation and dispersion of WBM drilling fluids and no significant habitats/biota are considered to be present in the Permit Area. The dilution of solid elements of the WBM into substrate largely depends on the energy level of the local environment and the 'mixing' that takes place, but is expected to occur rapidly following release (especially with WBM). The low sensitivity of the benthic communities/habitats combined with the low toxicity of WBM and low physical impacts affirm that any significant impact is considered unlikely.

Base fluids (i.e. base oil) are designed to be biodegradable in offshore marine sediments. Biodegradation can result in a low oxygen (anoxic) environment resulting in changes in benthic community structure. However, this is dependent on the bioavailability of the base fluid. Species sensitive to anoxic environments are eliminated and replaced by tolerant and opportunistic species, resulting in decreased species diversity, but the number of individuals often increases (Neff et al., 2000).

A small quantity of WBM and base oil residue may be discharged at the sea surface during cleaning of mud pits (<1%), typically at the conclusion of drilling activities. Nedwed et al. (2006) found that depth is an important factor for concentrations of base fluid on cuttings, where cuttings which had a great distance to reach the seabed (950 m) had significantly lower concentrations, suggesting that loss of base fluid during settling acted to significantly reduce chemical effects from discharges. This discharge is expected to dilute rapidly, with potential impacts to the environment considered to be a local, temporary decrease in water quality.

The low sensitivity of the benthic communities/habitats within and in the vicinity of the Permit Area, combined with the low toxicity of WBM, and the highly localised nature and scale of predicted physical impacts to seabed biota affirm that any significant impact is considered likely but of a slight environmental consequence.

Cumulative Impacts

Given the Petroleum Activities Program includes the drilling of six wells combined with the presence of 11 historical wells in the Permit Area, there is the potential for cumulative disturbance to marine sediment quality and benthic communities to occur. The cuttings and drilling fluids discharges from each of the wells will accumulate within the receiving environment. The most recently drilled well existing within the Permit Area was plugged and abandoned approximately six years ago. It is expected that the benthic habitat communities have fully recovered since then (aside from the cuttings in the immediate vicinity of the well head, from drilling the top hole section, which can modify the habitat), therefore posing no risk for significant cumulative impacts from historical wells. Therefore, cumulative impacts are expected to be limited to the Petroleum Activities Program.

The Permit Area is 1,388 km^2 and the total area for all seven well Operational Areas is only 25% of this area, much of which will not be significantly affected by cuttings. This reduces both the total area impacted and the likelihood of overlapping Operational Areas from the Petroleum Activities Program. When considering deposition of sediments from each drilling activity, deposition at a thickness of greater than 6.5 mm is limited to within a distance of a hundred metres, although this is dependent on the nature of the cuttings, and the water depth and currents of the receiving environment. Wells associated with the Petroleum Activities Program are likely to be spaced more than a few hundred metres apart and therefore areas where ecological impacts are expected, sedimentation greater than 6.5 mm, are not expected to overlap. However cumulative impacts from the appraisal wells may occur if drilled within a few hundred metres of an exploration well. In the event Woodside drills wells that overlap cutting field impacts are anticipated to be minimal, considering the observed limited benthic biota within the Permit Area.

No cumulative to water quality are expected to occur since discharged sediments are predicted to settle in between the drilling activities for each well and no concurrent drilling will occur.

Well annular fluids

The non-instantaneous nature of the release of the well annular fluids is expected to result in rapid dilution to a no-effect concentration within meters of the release location.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that the drill cutting and drilling muds discharges described will not result in a potential impact greater than localised burial and smothering of benthic habitats and slight/short term effects to water quality (e.g. turbidity increase). (i.e. Environment Impact - E)

Summary of Controls

- Implement Woodside's Chemical Selection and Assessment Environment Guideline for selection of drilling, completions, cementing and sub-sea control fluids and additives;

- Bulk operational discharges conducted under MODU's PTW system (to operate discharge valves/pumps);
- If discharging cuttings during SCE failure, measurement of OOC to occur more frequently from shakers;
- Mud pit wash residue will only be discharged if less than 1% by volume is oil content;
- Drill cuttings returned to the MODU will be processed using SCE equipment allowing reuse of mud prior to discharge. All drilling with riser in place will be undertaken using SCE to limit discharge of mud on cuttings;
- Discharge of cuttings below the water line in accordance with the Woodside Engineering Standard – Rig Equipment will reduce carriage and dispersion of cuttings by surface currents to keep impacts localised and ensure the impact evaluation remains applicable;

Routine and Non-routine Discharges to the Marine Environment: Cementing and Subsea Fluids

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Routine discharge of cement, cement cuttings, cementing fluids and subsea fluids (e.g. BOP control fluids and well suspension fluids) to the seabed and the marine environment.		X	X		X			E	1	L

Description of Source of Risk

Cementing Fluids and Cement

Cementing fluids are not routinely discharged to the marine environment. However, when cementing the conductor and surface casings after top-hole sections of the well have been drilled, cement must be circulated to the seabed to ensure structural integrity of the well. Excess cement is pumped to ensure structural integrity is achieved.

If the hole is completely in-gauge and there are no downhole losses while running the cement, a maximum average volume of 113 m^3 per well is estimated to be circulated to the seafloor at the well location, which forms a thin concrete film on the seabed in close proximity to the well.

After each cement job, left over cement slurry in the cement pump unit and the surface lines is flushed and discharged to the sea to prevent clogging of the lines and equipment. This is estimated at approximately 2 m^3 per well (based on 2-3 cement jobs per well x 3 bbls discharged per job).

Cement spacers can be used as part of the cementing process, within the well casing, to assist with cleaning of the casing sections prior to cement flow through. The spacers may consist of either seawater or a mixture of seawater and dye. The dye is used to provide a pre-indicator of cement overflow to the seabed surface, to ensure adequate cement height.

Excess cement (dry bulk, after well operations are completed) will either be: used for subsequent wells; provided to the next operator at the end of the drilling program (as it remains on the rig); or if these options aren't practicable discharged to the marine environment as a slurry (i.e. if contaminated or not meeting technical requirements).

Cement cuttings (~8 m^3 total volume) will be discharged during the re-entry of Noblige-1, due to drilling through existing cement plugs, however cuttings volumes will be significantly less that the usual drill cuttings volumes

Subsea Fluids BOP Control Fluids

Subsea Fluids likely to be released during drilling are BOP controls fluids. The BOP is required to be regularly function tested when subsea, as defined by legislative requirements. The BOP is function tested during assembly and maintenance and during operation on the seabed. As part of this testing, small volumes of BOP control fluid (generally consisting of water mixed with a glycol based detergent or equivalent water based anti-corrosive additive) is released to the marine environment. The hydraulic control fluid will be/will be similar to Stack-Magic (commercial name), which is biodegradable. For the Ferrand exploration well (used to inform the impact assessment) it has been determined that the BOP will be function tested every 7 days (when a pressure test is not occurring) and pressure tested a minimum of every 21 days as per API 53 (approximately 14 releases over drilling of Ferrand exploration well). This will result in discharges of approximately 68 L stack-magic per test.

Well Suspension Fluids

Upon re-entry into Noblige-1, existing suspension fluids (water-based drilling mud, KCl Brine and inhibited seawater) will be recovered and discharged in the same manner as regular water-based drilling fluids. If the suspension fluid has become contaminated with hydrocarbons, the fluids will be treated prior to discharge or returned to shore for disposal.

Impact Assessment
Potential Impacts to water quality, marine sediment quality and habitats and communities
Pelagic and benthic habitats in the Permit Area are considered to be of low sensitivity (no known significant benthic habitat or infauna habitat). Although the Exmouth Plateau KEF overlaps with the Permit Area, the values and

sensitivities of this KEF occur on a broad scale outside (99%) of the Permit Area. Coupled with the low toxicity of the fluids to be used for the Petroleum Activities Program, the likelihood of any significant impact to marine biota is considered to be low.

Cement and cement cuttings

Impacts of cement and cement cuttings on the marine environment are associated mainly with smothering of surrounding benthic and/or infauna communities. Cement is the most common material currently used in artificial reefs around the world (OSPAR, 2010) and is not expected to pose any toxicological impacts to receptors from leaching or direct contact. Cement volumes are calculated prior to its use, meanings excess cement should be minimal and discharges are not expected to widely disperse before settling on the seabed. The impact of cement discharge at the seabed will therefore, be limited to any surrounding benthic and/or infauna communities, in a small localised area immediately around the well and likely within the area previously impacted by drill cuttings.

Cementing Fluids, Subsea Fluids (BOP Control Fluids and Well Suspension Fluids)

All chemicals that may be operationally released or discharged to the marine environment are required to be selected and approved as per *Woodside Chemical Selection and Assessment Environment Guideline* (with the exception of well suspension fluids from Noblige-1 which were assessed as per the *Noblige-1 Drilling Program Environment Plan Bridging Document)* . Therefore, any chemicals selected and potentially released are expected to be of low toxicity and biodegradable. Additionally, where cements have been mixed in excess and cannot be reused or returned to shore these will be turned into a slurry. As chemicals have initially been chosen based on the environmental performance and based on an ALARP assessment, additional dilution prior to discharge further reduces the environment impact to water quality, sediment quality and marine benthic and/or infauna communities are reduced. Given the minor quantities of routine and non-routine planned discharges, short discharge durations and the low toxicity and high dispersion in the open, offshore environment, any impacts on the marine environment are expected to be slight and localised.

Given the highly localised nature of these discharges and potential impacts, cumulative impacts to marine biota, water quality and sediments are not expected.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that routine cement, cementing fluid and subsea fluid discharges described will not result in a potential impact greater than localised, slight and short term impacts to infauna and benthic communities, water quality and marine sediment (but not affecting ecosystems function). (i.e. Environment Impact - E)

Summary of Controls

- Implement Woodside's *Chemical Selection and Assessment Environment Guideline* for drilling, completions, fluids.
- Bulk operational discharges conducted under MODU's permit to Work (PTW) system (to operate discharge valves/pumps).
- Suspension fluids[4] recovered from Noblige-1 will be treated prior to discharge

[4] Note – this control refers to suspension fluids which may have come into contact with reservoir hydrocarbons.

Routine Atmospheric Emissions: Fuel Combustion, Flaring and Incineration

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Internal combustion engines and incinerators on MODU, ISV and support vessels				X				F	2	L
Flaring during DST				X				F	2	L

Description of Source of Risk

Atmospheric emissions will be generated by the project vessels from internal combustion engines (including all equipment and generators) and incineration activities (including onboard incinerators) during the Petroleum Activities Program. Emissions will include SO_2, NO_x, ozone depleting substances, CO_2, particulates and Volatile Organic Compounds (VOCs).

Woodside may undertake drill stem testing on any of the planned wells (including Ferrand). Drill stem testing will flow hydrocarbons from the well to the MODU, which will be flared. The volumes of hydrocarbons flared are unknown and subject to operational requirements. To inform the impact assessment, Woodside has estimated that drill stem testing may require intermittent flaring for up to 20 days, with between 600 and 900 million standard cubic feet of hydrocarbons flared per well. These estimates are based on Woodside's operational experience and are considered applicable for the Petroleum Activities Program.

Impact Assessment

Potential Impacts to Air Quality

Fuel combustion, flaring and incineration have the potential to result in localised, temporary reduction in air quality. Potential impacts include a localised reduction in air quality, generation of dark smoke and contribution to greenhouse gas emissions. Given the short duration and exposed location of the MODU, ISVs and support vessels (which will lead to the rapid dispersion of the low volumes of atmospheric emissions), the potential impacts are expected to have no lasting effect, with no cumulative impacts when considered in the context of existing or future oil and gas operations in the region.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that fuel combustion, flaring and incineration emissions will not result in a potential impact greater than a temporary decrease in local air quality and /or water quality standards with no lasting effect and no significant impact to environmental receptors. (i.e. Environment Impact - F)

Summary of Control Measures

- Marine Order 97 (Marine Pollution Prevention – Air Pollution); and
- Maintain a lit, efficient flare.

Routine Light Emissions: External Lighting on MODU, ISV and Support Vessels

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
External light emissions on-board MODU, ISV and project vessels						X		F	1	L

Description of Source of Risk

The MODU, ISVs and support vessels will have external lighting to facilitate navigation and safe operations at night throughout the Petroleum Activities Program. External light emissions from the MODU, ISV and support vessels are typically managed to maintain good night vision for crew members.

Lighting on the MODU is used to allow safe operations during night hours, as well as to communicate the MODU's presence and activities to other marine users (i.e. navigation lights). Lighting is required for the safe operation of the MODU and cannot reasonably be eliminated. Note that flaring, which is a relatively bright light source, may occur during drill stem testing.

External lighting is located over the entire MODU, with most external lighting directed towards working areas such as the main deck, pipe rack and drill floor. These areas are typically lower than 20 m above sea level when the MODU is on station. The highest point on the MODU is the top of the derrick, which is typically approximately 50 m above sea level. The distance to the horizon at which components of the MODU will be directly visible can be estimated using the formula below:

$$horizon\ distance = 3.57 \times \sqrt{height}$$

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 distances at which various MODU components (and associated light sources) will be visible at sea level are:

- Main deck (~20 m above sea level): approximately 16 km from MODU
- Derrick top (~50 m above sea level): approximately 25 km from MODU

Impact Assessment

Potential Impacts to Protected Species

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*: organisms such as marine turtles and birds may also use lighting from natural sources to orient themselves in a certain direction at night. In instances where an artificial light source is brighter than a natural source, the artificial light may act to override natural cues leading to disorientation.

The fauna within the Permit Area are predominantly pelagic fish and zooplankton, with a low abundance of transient species such as marine turtles, whale sharks and whales, and migratory sea birds transiting through the Permit Area. There is no known critical habitat within the Permit Area for EPBC listed species, although there is a migration BIA for pygmy blue whales, which are not expected to be impacted by above surface light emissions. Given the fauna expected to occur within the Permit Area, impacts from light emissions are considered to be highly unlikely.

Marine Turtles - Adults

Artificial lighting may affect the location that turtles emerge to the beach, the success of nest construction, whether nesting is abandoned, and even the seaward return of adults. Such lighting is typically from residential and industrial development overlapping the coastline, rather than offshore from nesting beaches. The Permit Area does not contain any known critical habitat for any species of marine turtle (nearest landfall (Montebello Islands) is located approximately 138 km from Permit Area) and all turtle BIAs are >80 km from the Permit Area. It is acknowledged that marine turtles may be present transiting the Permit Area in low densities; given the water depth (at least ~1,100 m) turtles are unlikely to be foraging within the Permit Area. Other Marine Fauna (migratory seabirds and fish).

Migratory Birds

The Permit Area may be occasionally visited by migratory and oceanic birds but does not contain any emergent land that could be utilised as roosting or nesting habitat and contains no known critical habitats (including feeding) of BIAs for any species. Seabird surveys over the Northwest Shelf Province, south and southeast of the Permit Area, have noted that seabird distributions in tropical waters were generally patchy, except near islands. Given the Permit Area lies further offshore from this area, with no islands in close proximity, seabirds are likely to only transit over the Permit Area when travelling between emergent land and important habitats. 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.The risk associated with collision from seabirds attracted to the light is considered to be low given the low numbers expected to transit the area and thatthere is no critical habitat for these species within the Permit Area, as well as the slow moving speeds associated with the MODU, ISV, and support vessels.

Fish

Lighting from the presence of a vessel may result in the localised aggregation of fish below the vessel. These aggregations of fish are considered localised and temporary and any long term changes to fish species composition or abundance is considered highly unlikely.

Summary of Potential Impacts to environmental values(s)

Light emissions from the MODU, ISV and support vessels will not result in an impact greater than localised and temporary disturbance to fauna in the vicinity of the Permit Area, with no lasting effect. (i.e. Environment Impact - F)

Summary of Control Measures

- The potential impacts and risks from light emissions are deemed to be ALARP in its current risk state. No reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice.

UNPLANNED ACTIVITIES (ACCIDENTS / INCIDENTS / EMERGENCY SITUATIONS)

Accidental Hydrocarbon Release: Loss of Well Integrity

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Loss of hydrocarbons to marine environment due to loss of well integrity.		X	X	X	X	X	X	B	2	H

Description of Source of Risk

Background

A loss of well integrity is an uncontrolled release of reservoir hydrocarbon or other well fluids to the marine environment, resulting from an over-pressured reservoir. Woodside has identified a blowout as the scenario with the worst case credible environmental outcome as a result of loss of well integrity. A blowout is an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers (e.g. the BOP) or activation of the same have failed.

Industry Experience

A risk assessment by AMSA of oil spills in Australian ports and waters concluded that:

- overall national exceedance frequency for oil spills from offshore drilling in Australia is 0.033 for spills > 1 tonne/year decreasing to 0.008 for spills > 100 tonnes/year
- blow-out probability for an exploration well was estimated to be 3.1 x 10-4 per well. This is based on data from the Gulf of Mexico, United Kingdom and Norway from 1980–2004, including wells that had BOPs installed
- probability of a blow-out from an oil exploration well is 2.5 x 10-4 (0.00025, or 0.025%).

Woodside has a good history of implementing industry standard practice in well design and construction. In the company's 60 year history, it has not experienced any well integrity events that have resulted in significant releases or significant environmental impacts.

Therefore, in accordance with the Woodside Risk Matrix, a loss of well integrity and resulting blowout event corresponds to an 'unlikely' event as it has occurred many times in the industry, but not in the Company.

Drilling Timeframe

Drilling is scheduled to occur throughout the year (all seasons), to provide operational flexibility for requirements and schedule changes and vessel / MODU availability.

Credible Scenario – well blowout

The Petroleum Activities Program consists of the drilling of six wells (up to 3 exploration wells and 3 appraisal wells) and the re-entry and plugging and abandoning of the Noblige-1 well. A loss of well integrity could result in a well blow out and hydrocarbon loss of containment at any of these six wells. Woodside identified the worst case credible spill scenario for a well blowout to be an uncontrolled surface release for five days, when the MODU would provide a conduit to the surface for the uncontrolled flow, followed by a 100-day uncontrolled seabed release as the MODU would no longer be present to provide a conduit.

The MODU would no longer be present after five days for the following reasons:

- In a non-explosion scenario, the MODU is likely to be moved off location as soon as is practicable to prevent escalation and further harm to personnel
- In an explosion scenario, the MODU is expected to sink due to an anticipated compromise in structural integrity and stability after a period of time. The most recent example of a similar scenario is the Deepwater Horizon incident, when the semi-submersible MODU sank after 36 hours following the uncontrolled loss of well control in the Gulf of Mexico in April 2010.

The 105 day (15 weeks) release duration assumes that the maximum depth of the hydrocarbon reservoir would be open and takes into account the estimated time to drill a relief well under the Mutual Aid Memorandum of Understanding (MoU).

It should be noted that the integrity of the wellbore is not affected in the highly unlikely event that the wellhead remains in-situ. Furthermore, if the wellhead is damaged, it is not credible for the reservoir to release hydrocarbons as the well will be abandoned in accordance with Woodside's Suspension and Abandonment Procedure and the Woodside Well Barrier Procedure.

Blowout volume

Woodside has determined that a blow-out from the Ferrand location would represent the worst case in terms of volume released. The Ferrand well is planned to test the deepest stratigraphic level and will be the deepest well (TD) penetrated within the Permit Area. The Ferrand structure is a large 4-way closure interpreted to have multiple stacked reservoir levels. In a success case the Ferrand exploration well will be deepened to 6500 mSS (5006 m below mud line). The worst case scenario for the EP is based on a blowout below the dry hole TD within the deeper (success case) interval. The other prospects identified in the Permit Area are likely to have reservoir targets at depths shallower than the Ferrand success case total depth. It was determined that the worst case credible total release for a well blowout associated with Ferrand was ~69,970 m^3, based on well design.

Note a credible scenario associated with the plug and abandonment of Noblige-1 is a loss of well integrity resulting in a hydrocarbon release to the environment. Based on design of the well, Woodside has determined that the credible release volume from a worst-case loss of well integrity of Noblige-1 is smaller than the worst-case release from Ferrand. Hence, the impact assessment based on the worst-case Ferrand scenario is considered to include all credible spills associated with the Noblie-1 well.

Quantitative Spill Risk Assessment – well blowout

Spill modelling was undertaken by RPS APASA, on behalf of Woodside, to determine the fate of hydrocarbon released for the 15-week blowout scenario at the Ferrand well location, based on the assumptions in **Table 11-4**. RPS APASA carried out the modelling based on a volume of ~69,970 m^3.

Table 11-4: Summary of modelled credible scenario – well blowout

	Loss of well integrity
Total discharge[5] at surface	5 days 9,420 m^3
Total discharge at Seabed	100 days 60,550 m^3
Water Depth	1,494 m
Fluid	Martin-1 condensate

Hydrocarbon Characteristics

An analogue fluid from the Outer Exmouth Plateau has been chosen, namely Martin -1. Martin-1 is also drilled the Mungaroo formation which contains sandstone reservoirs and coal /carbonaceous shale source rocks from which the Martin-1 fluid analogue is sourced. As Martin-1 was drilled in the same Permit Area, and the main proposed reservoirs are similar intra-Mungaroo sands and the same source rocks are believed to be charging the Ferrand structure as charged Martin-1. Martin-1 is an appropriate fluid analogue for wells proposed under the EP.

Table 11-5 Martin -1 wax and asphaltene content

Physical Property	Martin-1
Wax content	<5% wt wax (UOP A-46-40 Paraffin wax content)
Asphaltene content	<0.1%

As Martin-1 Condensate has high naphthenic and low wax content, this may affect the nature of the weathered oil residues. The most probable cause of a stable emulsions to form, and the stability across time, is the asphaltene content. Although asphaltenes are considered the prime source of crude oil emulsion stability in seawater, generally an asphaltene content of 0.5% or less is considered to have a lower tendency to form a stable water-in-oil emulsion. Martin-1 crude has a low asphaltene content (<0.1%) indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

[5] The discharge volumes in this table are predicted using reservoir modelling software packages that take into account a number of factors (well design, reservoir properties and environmental conditions (e.g. water depth, temperature and pressure) to provide a production profile over the oil spill modelling period.

Weathering processes under realistic variable wind conditions are illustrated in the example mass balance weathering graph for a discrete spill of 50 m^3 of Martin-1 condensate released at the surface, which is considered informative for this scenario (**Figure 11-1**). The graph demonstrates that approximately 50% of the released hydrocarbons would be expected to evaporate within the first 24 hours. Approximately 40% is expected to entrain within 72 hours, with approximately 5% expected to dissolve in the same time period, resulting in very little floating hydrocarbons on the surface after the first five days of release.

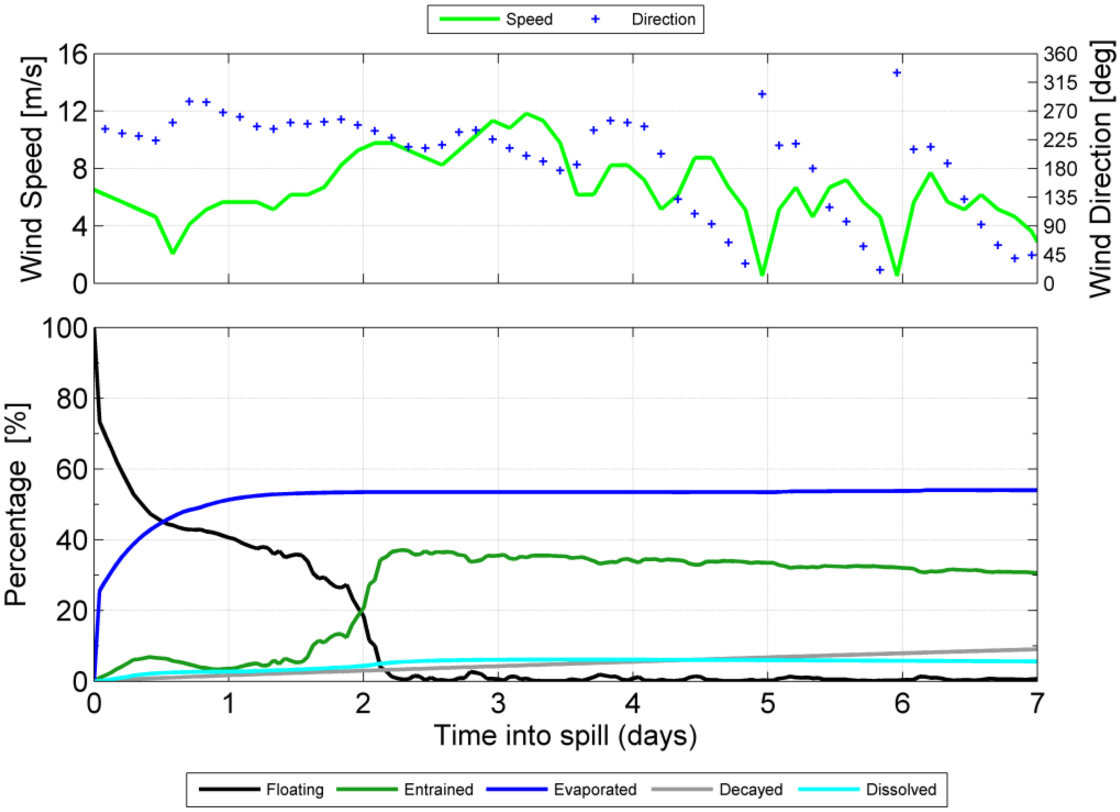

Figure 11-1: Proportional mass balance plot representing the weathering of 50m^3 from a surface spill of Martin-1 condensate

Subsea Plume dynamics

The well blowout surface/subsea release that has been modelled forecasts the size of the hydrocarbon droplets that would be released from the well as determined by the OILMAP-Deep model. **Table 11-6** shows a summary of the results of the OILMAP Deep modelling for the well blowout.

Table 11-6: Range of assumed inputs and range of calculated outputs, by OILMAP-Deep model for the surface/subsea well loss of containment

	Variable	Martin-1 condensate
Assumed discharge	Release Depth (m)	Surface (initial) 1,494 m (seabed release phase)
	Hydrocarbon temp (C°)	114°C
	Gas:Condensate ratio (scf/bbl)	~40,473
	Hydrocarbon flow rate (bbl/day)	4,084 – 4,283
	Diameter of exit hole (m)	0.445 m
Calculated gas plume dynamics	Plume diameter (m)	~143 m
	Plume Trapping height (m ASB)	635

Calculated droplet size distribution	droplets of size 909.8 µm	16.5 %
	droplets of size 1,819.6 µm	26.0 %
	droplets of size 2,729.4 µm	23.6 %
	droplets of size 3,639.2 µm	17.2 %
	droplets of size 4,549.0 µm	10.7 %
	droplets of size 5,458.8 µm	6.0 %

The blowout model (OILMAP-Deep) calculated that the discharge velocity and turbulence generated by the expanding gas plume will generate large oil droplets (diameter ranging from ~910 to ~5,459 µm). These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. The droplets will rise to the surface at rates determined by their buoyancy relative to the surrounding water density and the viscous resistance imposed by the water. Floating slicks are likely to be formed under calm wind conditions.

Impact Assessment

Potential Impacts Overview

Zone of Consequence

Surface Hydrocarbons: In the event this scenario occurred, a surface hydrocarbon slick would form down current of the well site with the trajectory dependent on prevailing wind and current conditions at the time. The slick is likely to drift in north-westerly and westerly directions. The modelling indicates the ZoC would be restricted to Commonwealth waters in the open ocean, and may extend for up to 165 km from the release site. The modelling did not predict contact by surface hydrocarbons above 10 g/m^2 for any sensitive receptor due to the rapid weathering (evaporation /entrainment) of the hydrocarbon as shown in **Figure 11-1**.

Entrained Hydrocarbons: In the event of the loss of well integrity scenario occurring, entrained hydrocarbons are forecast to potentially drift in all directions with the most likely directions of travel being to the west to south-west of the release site. The modelling indicated that the entrained hydrocarbon ZoC above the 500 ppb threshold concerntrations would be expected to contact Imperieus Reef at the Rowley Shoals to the north of the well site and Montebello/Barrow/Lowendal Islands Group, Dampier Archipelago, Southern Island Group, Southern Pilbara Islands, Muiron Islands, Ningaloo Coast, Shark Bay (open ocean coast) to the south of the well site. There is also the potential to contact the Abrolhos Islands and the Argo- Rowley Terrace CMR. **Table 11-7** indicates entrained threshold concerntrations contact locations for receptors as identified by the modelling. The ZoC may extend up to approximately 1,400 km south of the release site (<1% probability).

Dissolved Aromatic Hydrocarbons: In the event of the loss of well integrity scenario occurring, a plume of dissolved hydrocarbons would form down current of the well site with the trajectory dependent on prevailing current conditions at the time. The modelling indicates the ZoC would be restricted to Commonwealth waters in the open ocean, and may extend for up to approximately 320 km. No dominant drift direction is predicted, which suggests the aromatic compounds are more likely to evaporate from the water surface near the release site than be transported long distances by currents. The modelling did not predict contact by dissolved hydrocarbons above 500 ppb for any sensitive receptors.

Accumulated Hydrocarbons: Quantitative hydrocarbon spill modelling results for maximum local accumulated hydrocarbon concentrations indicated that the Ningaloo Coast, Indonesia (Lesser Sunda Ecoregion) and Shark Bay (Open Ocean Coast) were the only sensitive receptors predicted to experience shoreline accumulation above threshold concentrations (100 g/m^2). The overall worst-case locally accumulated shoreline concentration is forecast at Ningaloo Coast North (48 m^3). A maximum local shoreline concentration of 12 m^3 at Ningaloo Coast Middle is also forecast, with local accumulation of less than 6 m^3 predicted at all other receptors. The largest potential volume of oil accumulating on any shoreline is expected to be 48 m^3 at Ningaloo Coast North.

Summary of Potential Impacts

Table 11-7 presents the full extent of the ZoC, i.e. the sensitive receptors and their locations that may be exposed to hydrocarbons (surface, entrained, dissolved and accumulated) at or above the set threshold concentrations in the unlikely event of a major hydrocarbon release from a loss of well integrity during the Petroleum Activities Program. 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 11-7: ZoC – Key receptor locations and sensitivities with the summary hydrocarbon spill contact for a 105-day subsea blowout of Martin-1 condensate

Environmental setting	Location / name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate (Condensate)			
		Physical		Biological																						Socio-economic and Cultural								
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species										Other Species									
		Open water – (pristine)	Marine Sediment - (pristine)	Coral reef	Seagrass beds / Macroalgae	Mangroves	Spawning/nursery areas	Open water – Productivity/upwelling	Non biogenic coral reefs	Offshore filter feeders and/or Deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries / tributaries / creeks / lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Seasnakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident /Demersal Fish	Fisheries – commercial	Fisheries – traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Shipwrecks	Offshore Oil & Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥500 ppb)	Dissolved aromatic hydrocarbon (≥500 ppb)	Accumulated hydrocarbons (≥100 g/m²)
Offshore[6]	Commonwealth waters	✓	✓					✓		✓					✓	✓				✓	✓	✓	✓	✓		✓		✓		✓	X	X	X	
	Agro-Rowley Terrace CMR	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓			X		
	Montebello CMR	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓*			X		
	Carnarvon Canyon CMR	✓	✓					✓		✓														✓	✓	✓			✓			X		
	Ningaloo CMR	✓						✓		✓					✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓			X		
	Gascoyne CMR	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		X		
	Shark Bay Open Ocean (including CMR)	✓	✓					✓							✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓			X		
	Imperieuse Reef (Rowley Shoals Marine Park)	✓	✓	✓			✓	✓		✓						✓			✓	✓		✓	✓	✓	✓			✓	✓			X		
Submerged Shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓				X		

[6] Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent

Environmental setting	Location / name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																											Hydrocarbon contact and fate (Condensate)			
		Physical		Biological																						Socio-economic and Cultural								
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species										
		Open water – (pristine)	Marine Sediment - (pristine)	Coral reef	Seagrass beds / Macroalgae	Mangroves	Spawning/nursery areas	Open water – Productivity/upwelling	Non biogenic coral reefs	Offshore filter feeders and/or Deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries / tributaries / creeks / lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Seasnakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident /Demersal Fish	Fisheries – commercial	Fisheries – traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Shipwrecks	Offshore Oil & Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥500 ppb)	Dissolved aromatic hydrocarbon (≥500 ppb)	Accumulated hydrocarbons (>100 g/m²)
Islands	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			X		
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		X		
	Muiron Islands (WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓			X		
	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓			X		
	Abrolhos Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓			X		
Mainland (nearshore	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			X		X
	Shark Bay – Open Ocean Coast (WHA),	✓	✓	✓	✓		✓	✓			✓	✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓			X		X

Environmental setting	Location / name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																												Hydrocarbon contact and fate (Condensate)			
		Physical		Biological																				Socio-economic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species									
		Open water – (pristine)	Marine Sediment - (pristine)	Coral reef	Seagrass beds / Macroalgae	Mangroves	Spawning/nursery areas	Open water – Productivity/upwelling	Non biogenic coral reefs	Offshore filter feeders and/or Deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries / tributaries / creeks / lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Seasnakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident /Demersal Fish	Fisheries – commercial	Fisheries – traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Shipwrecks	Offshore Oil & Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥500 ppb)	Dissolved aromatic hydrocarbon (≥500 ppb)	Accumulated hydrocarbons (>100 g/m²)
	including Bernier and Dorre Islands																																	
Indonesia	Lesser Sunda Region	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓					X

Summary of Potential Impacts to environmental values(s)	
Summary of Potential Impacts to protected species	
Setting	***Receptor Group***
Offshore	**Cetaceans**: Marine mammals that have direct physical contact with surface, entrained or dissolved aromatic hydrocarbons may suffer surface fouling, ingestion of hydrocarbons (from prey, water and sediments), aspiration of oily water or droplets and inhalation of toxic vapours. This may result in the irritation of sensitive membranes such as the eyes, mouth, digestive and respiratory tracts and organs, impairment of the immune system, neurological damage, reproductive failure, adverse health effects (e.g. lung disease, poor body condition) and potentially mortality. In a review of cetacean observations in relation to a number of large scale hydrocarbon spills, Geraci (1988) found little evidence of mortality associated with hydrocarbon spills however it was concluded that exposure to oil from the deepwater horizon resulted in increased mortality to cetaceans in the Gulf of Mexico. Geraci (1988) did identify behavioural disturbance (i.e. avoiding spilled hydrocarbons) in some instances for several species of cetacean suggesting that cetaceans have the ability to detect and avoid surface slicks. However, observations during spills have recorded larger whales (both mysticetes and odontocetes) and smaller delphinids traveling through and feeding in oil slicks. During the deepwater horizon spill cetaceans were routinely seems swimming in surface slicks offshore (and nearshore). In the event of a well blowout, surface, entrained and dissolved hydrocarbons exceeding threshold concentrations may drift across habitat for oceanic cetacean species and the migratory routes and BIAs of EPBC Act listed whale species, including humpback whales and pygmy blue whales (north- and southbound migrations). Impacts to cetaceans will depend on the exposure pathway; with exposure to entrained oil and surface slicks not expected to result in significant impacts due to the relatively volatile, non-persistent nature of the hydrocarbons. Direct toxic effects from external exposure are not expected to occur, although irritation to mucous membranes and eyes may occur. Indirect toxic effects, such as hydrocarbon ingestion through accumulation in prey may occur. This is not expected to occur in migrating baleen whales, such as pygmy blue and humpback whales, which are known to primarily feed in the Southern Ocean (although may undertake opportunistic feeding during migrations). Note that baleen whales feeding within entrained hydrocarbon plumes may ingest hydrocarbons, potentially resulting in toxic effects (particularly fresh hydrocarbons near the release location). Cetacean populations that are resident within the potential ZoC 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). Impacts from physical contact with hydrocarbons are likely to be in the form of irritation and sub-lethal biological effects (e.g. skin irritation, reproductive failure) and in rare circumstances, death. Suitable habitat for oceanic toothed whales (e.g. sperm whales) and dolphins (e.g. spinner dolphin) is broadly distributed throughout the region and as such, impacts are unlikely to affect an entire population. Other species may also have possible transient interactions with the ZoC (Refer **ZOC TABLE** for the list of receptor locations important for cetaceans). Physical contact with hydrocarbons to these species may result in biological consequences (considered unlikely as the spilled hydrocarbon is expected to weather quickly), however it is unlikely to affect an entire population and not predicted to impact on the overall population viability. Pygmy blue whales and humpback whales are known to migrate seasonally through the potential spill affected area for surface, dissolved and entrained hydrocarbons. A major spill in July to December would coincide with humpback whale migration through the waters off the Pilbara, North West Cape (Ningaloo) and Shark Bay (open ocean). A major spill in April to August or October to December would coincide with pygmy blue whale migration. Double *et al*. (2014) suggest that pygmy blue whales migrate in offshore waters through the Permit Area in approximately 200–1000 m of water. The pygmy blue whale migration BIA lies within the Permit Area and the humpback whale migration BIA within the wider ZoC and may be overlapped by a worst-case hydrocarbon spill. However, feeding during migrations is low level and opportunistic. As such, the risk of ingestion of hydrocarbons is low. Migrations of both pygmy blue whales and humpback whales are protracted through time and space (i.e. the whole population will not be within the ZoC), and as such, a spill from the loss of well integrity is unlikely to affect an entire population. The humpback whale resting area in Exmouth Gulf and the calving area in Camden Sound are not predicted to be contacted by surface, entrained or dissolved hydrocarbons above threshold concentrations. A loss of well integrity resulting in a well blowout could result in a disruption to a significant portion of the humpback or pygmy blue whale populations. Such disruption could include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation, reproductive failure) and, in rare circumstances, death. However, such

	disruptions or impacts are not predicted to impact on the overall population viability of cetaceans within the ZoC.
	Marine Turtles: All life stages (see *Mainland and Island (nearshore)* for discussion on nesting adult females, foraging adults and hatchlings) are at risk of oiling due to marine turtles need to surface to breath. However, exposure is more acute for juvenile marine turtles which spend nearly all their time in the top two metres of the water column. Adult sea turtles exhibit no avoidance behaviour when they encounter hydrocarbon slicks. Contact with surface slicks, or entrained hydrocarbon, can therefore, result in hydrocarbon adherence to body surfaces causing irritation of mucous membranes in the nose, throat and eyes leading to inflammation and infection. Oiling can result in ingestion of hydrocarbons and indicators of PAH were higher in tissues, stomach content, colon content and faeces of visibly oiled turtles compared to non-visibly oiled turtles. A stress response associated with this exposure pathway includes an increase in the production of white blood cells, and even a short exposure to hydrocarbons may affect the functioning of their salt gland. Oiling can result in mortality depending on the extent of oiling and the size of the marine turtle. Hydrocarbons in surface waters may also impact turtles when they surface to breathe and inhale toxic vapours. Their breathing pattern, involving large ‘tidal’ volumes and rapid inhalation before diving, results in direct exposure to petroleum vapours which are the most toxic component of the hydrocarbon spill. This can lead to lung damage and congestion, interstitial emphysema, inhalant pneumonia and neurological impairment. Contact with entrained hydrocarbons can result in hydrocarbon adherence to body surfaces causing irritation of mucous membranes in the nose, throat and eyes leading to inflammation and infection. Given the nature of the hydrocarbon, which is not expected to form surface slicks in areas where turtles are likely to occur in high densities (e.g. near nesting areas, foraging habitat etc.), inhalation of harmful concentrations of hydrocarbon vapour by turtles (and other air breathing fauna) is considered to be very unlikely. Due to the absence of potential nesting habitat and location offshore, the Permit Area is unlikely to represent important habitat for marine turtles (approximately 137 km to the Montebello Islands and water depths of approximately 1,100 m to 1,600 m deep). However, it is noted by Woodside that the Petroleum Activities Program may coincide with nesting season for marine turtles in the region. Foraging / transiting adult marine turtles and oceanic juvenile marine turtles may be present within the ZoC, and are most likely to be impacted while there is free-release of hydrocarbons from the well in the offshore area. During the Deepwater Horizon spill nearly all heavily oiled turtles were found within 90 km of the location of the well site. Note that the nearest turtle BIA, an extensive flatback internesting buffer, lies approximately 80 km from the Permit Area at the closest point. It was determined that oceanic juvenile turtles were the life stage most affected by the spill in the Gulf of Mexico, through both direct oiling and loss of habitat / food (exposure of *Sargassum* to oil can cause it to sink*),* with mortality of small juvenile turtles estimated to be in the thousands. A spill from the loss of well integrity is unlikely to affect an entire population or life stage as both adult and juvenile marine turtles are expected to be broadly distributed throughout the offshore NWMR. In the event of a well blowout, there is potential that surface, entrained and dissolved hydrocarbons exceeding threshold concentrations will be present in offshore waters extending up to 165 km, 1,400 km and 320 km, respectively, from the release site. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population; however, there is no threat to overall population viability. Potential impacts to internesting marine turtles are discussed in the *Mainland and Islands (nearshore)* impacts discussion.
	Seasnakes: Impacts to seasnakes from direct contact with hydrocarbons are likely to result in similar physical effects to those recorded for marine turtles and may include potential damage to the dermis and irritation to mucus membranes of the eyes, nose and throat. They may also be impacted when they return to the surface to breathe and inhale the toxic vapours associated with the hydrocarbons, resulting in damage to their respiratory system. In general, seasnakes frequent the waters of the continental shelf area around offshore islands and potentially submerged shoals (water depths <100 m; see Submerged Shoals below) and while individuals may be present in the offshore oceanic waters, their abundance is not expected to be high given the deep water and offshore location of the activity. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population but there is no threat to overall population viability.
	Sharks (including whale sharks) and Rays: Hydrocarbon contact may affect whale sharks through ingestion (entrained/dissolved hydrocarbons), particularly if feeding. Whale sharks may transit offshore open waters, including the Permit Area, 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 also carry out opportunistic feeding in offshore waters and the ZoC overlaps the whale shark migration BIA. The whale sharks are seasonally present within the BIA between April and October and the wider ZoC overlaps an aggregation area at Ningaloo. Therefore, individual whale sharks that have direct contact with hydrocarbons within the spill affected area may be impacted but the consequences to migratory whale shark populations are likely to be minor. Impacts to sharks and rays (including giant manta rays) may occur through direct contact with hydrocarbons and contaminate the tissues and internal organs either through direct contact or via the food chain (consumption of prey). In the offshore environment, it is probable that pelagic shark species are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Whale sharks may ingest or be subject to gill coating when feeding in an entrained hydrocarbon plume. The potential impacts are expected to range depending on the weathered state of the hydrocarbon. Impacts may include toxic effects (more likely to occur when exposed to fresh hydrocarbons) to impaired gas and ion exchange through the gills due to hydrocarbon fouling. Therefore, any impact on sharks and rays is predicted to be minor and only a temporary disruption.
	Seabirds and/or Migratory Shorebirds: Offshore waters are potential foraging grounds for seabirds associated with the coastal roosting and nesting habitat (Ningaloo and the Barrow/Montebello/Lowendal Island Group). There are confirmed foraging grounds off Ningaloo and the Barrow/Montebello/Lowendal Island Group. There are a number of BIAs for seabirds and migratory shorebirds that overlap with the wider ZoC. Seabirds generally do not exhibit avoidance behaviour to floating hydrocarbons. Physical contact of seabirds with surface slicks is by several exposure pathways, primarily, immersion, ingestion and inhalation. Such contact with hydrocarbons may result in plumage fouling and hypothermia (loss of thermoregulation), decreased buoyancy and potential to drown, inability to fly or feed, anaemia, pneumonia and irritation of eyes, skin, nasal cavities and mouths and result in mortality due to oiling of feathers or the ingestion of hydrocarbons. Longer term exposure effects that may potentially impact seabird populations include a loss of reproductive success (loss of breeding adults) and malformation of eggs or chick. However, the extent of the ZoC for a surface slick as a result of a well blowout is predicted to be limited to approximately 165 km from the release location. Therefore, a hydrocarbon spill is unlikely to result in the disruption of a significant portion of the foraging habitat for seabirds.
Submerged shoals	**Marine Turtles:** There is the potential for marine turtles to be present at submerged shoals such as Rankin Bank and Rowley Shoals. These shoals and banks may, at times, be a foraging habitat for marine turtles, given the coral and filter feeding biota associated with these areas. However, these areas are not known foraging locations and satellite tracking of individual green turtles in the nearshore environment of the NWS did not indicate any overlap of the tracked post-nesting migratory routes and the Permit Area. It is, however, acknowledged that individual marine turtles may be present at Rankin Bank and Rowley Shoals and the surrounding areas. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population (see offshore description above); however, there is no threat to overall population viability.
	Seasnakes: There is the potential for seasnakes to be present at submerged shoals such as Rankin Bank and Rowley Shoals. The potential impacts of exposure are as discussed previously in Offshore – Seasnakes. A hydrocarbon spill may have a minor disruption to a portion of the population but there is no threat to overall population viability. Seasnake species in Australia generally show strong habitat preferences; species that have preferred habitats associated with submerged shoals and oceanic atolls may be disproportionately affected by a hydrocarbon spill affecting such habitat.
	Sharks (including whale sharks) 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 potential impacts to the benthic communities of Rankin Bank and Rowley Shoals. Pelagic and transient sharks and rays are expected to move away from areas affected by spilled hydrocarbons. Impacts to such species are expected to be limited to behavioural responses/displacement. Shark and ray species that have associations with submerged shoals and oceanic atolls may not move in response to such habitat being contacted by spilled hydrocarbons. Such species may be more susceptible to a reduction in habitat quality resulting from a hydrocarbon spill. Impacts to sharks and rays at Rankin Bank and Rowley Shoals are likely to be localised as they are comparable to other Australian reefs and the NWMR submerged shoals and banks. It is expected that there will be no impacts at the population level.
Mainland	**Cetaceans and Dugongs:** In addition to a number of whale species that may occur in nearshore

and Islands (nearshore waters)	waters, coastal populations of small cetaceans (such as spotted bottlenose dolphins and Indo-Pacific humpback dolphins) and dugongs are known to reside or frequent nearshore waters, including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands, Pilbara Southern Island Groups, and Shark Bay, and a number of other nearshore and coastal locations including coastal areas of the Indonesian archipelago which may be potentially impacted by entrained hydrocarbons exceeding threshold concentrations in the event of a loss of well containment. The predicted ZoC for entrained hydrocarbon extends past Exmouth Gulf and down to Shark Bay. These areas are known humpback whale aggregation areas during their annual southern migration (September to December) and therefore, humpbacks moving into these aggregations areas may be exposed to hydrocarbons above thresholds levels. However, surface, 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, the potential for sustained exposure may be greater, however hydrocarbons reaching these environments will be highly weathered, with volatile and water soluble (often the most toxic components) expected to have dissipated prior to reaching nearshore waters. In the Gulf of Mexico nearshore bottlenose dolphins, experienced mortality, reproductive failure and adverse health effects at high levels than those of oceanic stocks during the Deepwater Horizon spill. Additional potential environment impacts may also include the potential for dugongs and dolphins to ingest hydrocarbons when feeding on oiled seagrass stands or contaminated sediments. There are also potential indirect impacts to dugongs due to loss of this food source due to dieback in worse affected areas. Therefore, a hydrocarbon spill may have an impact on feeding habitats and result in a disruption to a significant portion of the local population but it is not predicted to result in impacts on overall population viability of either dugongs or coastal cetaceans.
	Pinnipeds: Australian sea lions are found in the Houtman Abrolhos Islands Nature Reserve (approximately 666 km from the Permit Area). Given the considerable distance from the Permit Area to these receptors and the lengthy time for entrained hydrocarbons to contact (minimum 82 days), entrained hydrocarbons that do reach this area are likely to be heavily weathered and are expected to have minor or no impacts on sea lions.
	Marine Turtles: Several marine turtle species utilise nearshore waters and shorelines for foraging and breeding (including internesting), with significant nesting beaches along the mainland coast and islands in potentially impacted locations such as the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands, Pilbara Islands (Southern Island Groups) and Shark Bay. There are distinct breeding seasons. The nearshore waters of these turtle habitat areas may be exposed to entrained hydrocarbons exceeding threshold concentrations, and accumulated hydrocarbons above threshold concentrations (Ningaloo Coast and Shark Bay only). 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). In addition, hydrocarbon exposure can impact on turtles during the breeding season at nesting beaches. Contact with gravid adult females or hatchlings may occur on nesting beaches (accumulated hydrocarbons) or in nearshore waters (entrained hydrocarbons) where hydrocarbons are predicted to make shoreline contact. In the event that accumulated hydrocarbons (Ningaloo Coast and Shark Bay only) or entrained hydrocarbons reach the shoreline or internesting coastal waters (refer to **Table 11-7** for receptor locations), there is the potential for impacts to turtles utilising the affected area. Animals that lay eggs have been shown to pass metabolized oil related compounds into their offspring which has the potential to be toxic to the development embryos Similarly, adult female turtles can pass metabolized oil and related products to their eggs, thereby potentially exposing developing embryos and impairing the development and survival of embryos. During the breeding season, turtle aggregations near nesting beaches within the wider ZoC are most vulnerable due to greater turtle densities and potential impacts may occur at the population level but is not expected to impact on overall population viability.
	Seasnakes: As discussed previously (see ‘Submerged shoals – seasnakes’) impacts to seasnakes for the mainland and island nearshore waters (including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands, Southern Pilbara Island Groups and Shark Bay) from direct contact with hydrocarbons may occur but there is expected to be no threat to overall population viability.
	Sharks (including whale sharks) and Rays: Whale sharks and manta rays, known to frequent the

	Ningaloo Reef system and the Muiron Islands (and form feeding aggregations in late summer/autumn) and transit along the Pilbara cost 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. Whale sharks at Ningaloo Reef have been observed using two different feeding strategies, including passive sub-surface ram-feeding and active surface feeding. Passive feeding consists of swimming slowly at the surface with the mouth wide open. During active feeding sharks swim high in the water with the upper part of the body above the surface with the mouth partially open. These feeding methods would result in the potential for individuals that are present in worse affected spill areas to ingest potentially toxic amounts of surface, entrained or dissolved aromatic hydrocarbons into their body. Large amounts of ingested hydrocarbons may affect their endocrine and immune system in the longer term. The presence of hydrocarbons may cause displacement of whale sharks from the area where they normally feed and rest, and potentially disrupt migration and aggregations to these areas in subsequent seasons. Whale sharks may also be affected indirectly by surface, entrained or dissolved aromatic hydrocarbons through the contamination of their prey. The preferred food of whale sharks are fish eggs and phytoplankton which are abundant in the coastal waters of Ningaloo Reef in late summer/autumn, driving the annual arrival and aggregation of whale sharks in this area. If the spill event were to occur during the spawning season, this important food supply (in worse spill affected areas of the reef) may be diminished or contaminated. The contamination of their food supply and the subsequent ingestion of this prey by the whale shark may also result in long term impacts as a result of bioaccumulation. There is the potential for other resident shark and ray populations ray (e.g. sawfish species) to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat. However, it is probable that shark species will move away from the affected areas. **Table 11-7** 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 on the overall viability of the population.
	Seabirds and/or Migratory Shorebirds: In the unlikely event of a major spill, there is the potential for seabirds, and resident and non-breeding overwintering shorebirds that use the nearshore waters for foraging and resting, to be exposed to surface,entrained and dissolved hydrocarbons. This could result in lethal or sublethal effects. Although breeding oceanic seabird species can travel long distances to forage in offshore waters, most breeding seabirds tend to forage in nearshore waters near their breeding colony, resulting in intensive feeding by higher seabird densities in these areas during the breeding season and making these areas particularly sensitive in the event of a spill. Pathways of biological exposure that can result in impact may occur through ingestion of contaminated fish (nearshore waters) or invertebrates (intertidal foraging grounds such as beaches, mudflats and reefs). Ingestion can also lead to internal injury to sensitive membranes and organs. Whether the toxicity of ingested hydrocarbons is lethal or 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. Refer to **Table 11-7** for locations within the predicted extent of the ZoC that are identified as habitat for seabirds/migratory shorebirds. Suitable habitat or seabirds and shorebirds are broadly distributed along the mainland and nearshore island coasts within the ZoC. Of note are important nesting and resting areas, including: • Muiron Islands • Ningaloo Coast • Montebello/Barrow/Lowendal Islands group (including known nesting habitats on Boodie, Double and Middle Islands) • Pilbara Islands South Island Group • Shark Bay • Abrolhos Islands. Therefore, a hydrocarbon spill may result in impacts on key feeding habitat and a disruption to a significant portion of the habitat however this is not expected to result in a threat to the overall population viability of seabirds or shorebirds.
Indonesia	**Marine Turtles:** The islands within the Lesser Sunda Ecoregion provide habitat for marine turtles, with the Laut Sawu Marine National Park, in particular, identified as providing habitat for five species of

	marine turtles – green, leatherback, olive ridley, loggerhead and flat back turtles. The potential impacts to marine turtles contacted by accumulated hydrocarbons on shorelines are likely to be similar to those described above for Mainland and Islands (nearshore waters) – Marine Turtles.
	Seabirds and/or Migratory Shorebirds: Whilst there is little publically information on the status of seabirds and migratory shorebirds in Indonesia, the Lesser Sunda ecoregions are within the East Asian Flyway for migratory shorebirds, and the two ecoregions support habitat for seabirds. The potential impacts from accumulated hydrocarbons on shorelines to seabirds and migratory shorebirds are discussed above for Mainland and Islands (nearshore waters) – Seabirds and/or Migratory Shorebirds. Whilst a spill resulting in accumulated hydrocarbons on Indonesian shorelines may result in impacts feeding habitat and a disruption to a portion of the habitat, it is not expected to result in a threat to the overall population viability of seabirds or shorebirds.
Summary of potential impacts to marine primary producers	
Setting	***Receptor Group***
Submerged Shoals	The waters overlying the submerged Rankin Bank and Rowley Shoals have the potential to be exposed to entrained hydrocarbons above threshold concentrations (at or greater than 500 ppb). This permanently submerged habitat represents sensitive open water benthic community receptors, extending from deep depths to relatively shallow water. Given the depth of Rankin Bank and Rowley Shoals, it is likely the potential for biological impact is significantly reduced when compared to the upper water column layers. However, potential biological impacts could include sub-lethal stress and in some instances total or partial mortality of sensitive benthic organisms such as corals and the early life stages of resident fish and invertebrate species.
Mainland and Islands (nearshore waters)	**Coral Reef**: The quantitative spill risk assessment and ZoC indicate there would be potential for coral reef habitat to be exposed to for entrained hydrocarbons (≥500 ppb threshold concentration) to contact shallow nearshore waters and therefore exposure of subtidal corals associated with the fringing reefs located at a number of mainland and island locations. Areas that may be contacted by entrained hydrocarbons (≥500 ppb threshold concentration) include the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands Group, Pilbara Southern Islands Groups, and Shark Bay. There is the potential for these reefs to be exposed to entrained hydrocarbons concentrations that are considered to induce toxicity effects, particularly for reproductive and juvenile stages of invertebrate and fish species. Exposure to entrained hydrocarbons (≥500 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 (with reference to Ningaloo Coast). Mortality in a number of coral species is possible and this would result in the reduction of coral cover and change in the composition of coral communities. 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. This could result in impacts to the shallow water fringing coral communities/reefs of the offshore islands (e.g. Barrow/Montebello/Lowendal Islands) and also the mainland coast (e.g. Ningaloo Coast). With reference to Ningaloo Reef, wave-induced water circulation flushes the lagoon and may promote removal of entrained hydrocarbons from this particular reef habitat. Under typical conditions, breaking waves on the reef crest induce a rise in water level in the lagoon creating a pressure gradient that drives water in a strong outward flow through channels. These reef incises are across as much as 15% of the length of Ningaloo Reef. In the unlikely event of a spill occurring at the time of coral spawning at potentially affected coral locations or in the general peak period of biological productivity, there is potential for a significant reduction in successful fertilization and coral larval survival due to the sensitivity of coral early life stages to hydrocarbons. Such impacts are likely to result in the failure of recruitment and settlement of new population cohorts. In addition, some non-coral species may be affected via direct contact with entrained and dissolved aromatic hydrocarbons, resulting in sub-lethal impacts and in some cases mortality. This is with particular reference to the early life-stages of coral reef animals (reef attached fishes and reef invertebrates), which can be relatively sensitive to hydrocarbon exposure. Coral reef fish are site attached, have small home ranges and as reef residents they are at higher risk from hydrocarbon exposure than non-resident, more wide-ranging fish species. The exact impact on resident coral communities (which may include fringing reefs of the offshore islands and/or the Ningaloo reef system) will be entirely dependent on actual hydrocarbon concentration, duration of exposure and water depth of the affected communities. Over the worst affected sections of reef habitat, coral community live cover, structure and composition is predicted to reduce, manifested by loss of corals and associated sessile biota. Recovery of these impacted reef areas relies on coral larvae from neighbouring coral communities that have either not

	been affected or only partially impacted. For example, there is evidence that Ningaloo Reef corals and fish are partly self-seeding with the supply of larvae from locations within Ningaloo Reef of critical importance to the healthy maintenance of the coral communities. Recovery at other coral reef areas, including Scott Reef, may not be aided by a large supply of larvae from other reefs, with levels of recruits after a disturbance event only returning to previous levels after the numbers of reproductive corals had also recovered. Therefore, a hydrocarbon spill may result in large-scale impacts to coral reefs, with long-term effects (recovery >10 years) possible.
	Seagrass Beds / Macroalgae and Mangroves: Spill modelling has predicted entrained hydrocarbons ≥500 ppb have the potential to contact a number of shoreline sensitive receptors such as those supporting biologically diverse, shallow subtidal and intertidal communities. The variety of habitat and communities types, from the upper subtidal to the intertidal zones support a high diversity of marine life and are utilised as important foraging and nursery grounds by a range of invertebrate and vertebrate species. Depending on the trajectory of the entrained plume, macroalgal/seagrass communities including the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms), Muiron Islands (associated with limestone pavements), the Barrow/Montebello/ Lowendal Islands, Shark Bay, the Pilbara Southern Island Group (documented as low and patchy cover) and the Abrolhos Islands have the potential to be exposed (see **Table 11-7** for a full list of receptors within the ZoC). Seagrass and macroalgal beds occurring in the intertidal and subtidal zone may be susceptible to impacts from entrained hydrocarbons. Toxicity effects can also occur due to absorption of soluble fractions of hydrocarbons into tissues. The potential for toxicity effects of entrained hydrocarbons may be reduced by weathering processes that should serve to lower the content of soluble aromatic components before contact occurs. Exposure to entrained aromatic hydrocarbons may result in mortality, depending on actual entrained aromatic hydrocarbon concentration received and duration of exposure. Physical contact with entrained hydrocarbon droplets could cause sub-lethal stress, causing reduced growth rates and a reduction in tolerance to other stress factors. Impacts on seagrass and macroalgal communities are likely to occur in areas where hydrocarbon threshold concentrations are exceeded. Mangrove habitat and associated mud flats and salt marsh at Ningaloo Coast (small habitat areas), the Pilbara islands and the Montebello Islands have the potential to be exposed (see **Table 11-7** for the full list of receptors). Mangroves can be impacted by entrained aromatic hydrocarbons that may adhere to the sediment particles. In low energy environments such as in mangroves, deposited sediment-bound hydrocarbons are unlikely to be removed naturally by wave action and may be deposited in layers by successive tides. The hydrocarbon comprises a proportion of persistent residual fractions (Martin-1 condensate comprises of 25.8% of persistent fractions) and therefore deposited hydrocarbons may persist in the sediment potentially causing chronic sub-lethal toxicity impacts beyond immediate physical and acute effects which may delay recover in an affected area. Recovery of mangroves from oil spills can take 20-30 years therefore recovery from any impacts would be long-term (>10 years). Entrained hydrocarbon impacts may include sub-lethal stress and mortality to certain sensitive biota in these habitats, including infauna and epifauna. Larval and juvenile fish, and invertebrates that depend on these shallow subtidal and intertidal habitats as nursery areas, may be directly impacted due to the loss of habitats and/or lethal and 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 utilise these intertidal habitat areas for breeding, feeding and nursery habitat purposes.
Summary of potential impacts to other species	
Setting	***Receptor Group***
Offshore	**Pelagic Fish Populations:** Fish mortalities are rarely observed to occur as a result of hydrocarbon spills. Scholz *et al*. (1992) concluded that fish do not generally experience acute mortality due to hydrocarbon spills, and that it is rare to find fish kills after a spill, especially in open water environments. This has generally been attributed to the possibility that pelagic fish are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Fish that have been exposed to dissolved aromatic hydrocarbons are capable of eliminating the toxicants once placed in clean water, hence, individuals exposed to a spill are likely to recover. 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. A spill of condensate due to a loss of well containment associated with the Petroleum Activities Program is therefore, unlikely to cause a major impact on short-term survival of open water pelagic fish but may result in a level of sub-lethal stress on fish. The potential impacts to fish populations in open waters

	are considered to be minor and localised.
	Demersal Fish: The continental slope demersal fish communities and the western demersal slope and associated fish communities KEFs occur within the wider ZoC. Mortality and sub lethal effects may impact populations located close to the well blow out and within the ZoC for entrained/dissolved aromatic hydrocarbons (≥500 ppb). Additionally, if prey (infauna and epifauna) surrounding the well location and within the ZoC is contaminated, this can result in the absorption of toxic components of the hydrocarbons (PAHs) potentially impacting fish populations that feed on these. These impacts may result in localised medium/long term impacts on demersal fish habitat, e.g. seafloor. 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. 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. 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.
Submerged Shoals	**Pelagic Fish Populations**: Detection and avoidance predicted for pelagic fish populations (see offshore description above).
	Demersal Fish: Mortality and sub lethal effects may impact populations within the ZoC for entrained hydrocarbons (≥500 ppb). Additionally, if prey (infauna and epifauna) within the ZoC is contaminated, this can result in the absorption of toxic components of the hydrocarbons (PAHs) potentially impacting fish populations that feed on these. These impacts may result in localised medium/long term effects on demersal fish habitat, e.g. seafloor at affected submerged shoals (e.g. Ranking Bank and Rowley Shoals)
	Resident Fish: Site-attached fish (for example coral reef fish), 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 fish populations, at impacted shoals (e.g. Ranking Bank and Rowley Shoals), will be entirely dependent on actual hydrocarbon concentration, duration of exposure and water depth of the affected communities. It is also noted that the early life stages (larval and fingerling) of resident fish populations are particularly sensitive to hydrocarbon exposure.
Mainland and islands (nearshore waters)	**Pelagic Fish Populations:** Detection and avoidance predicted for pelagic fish populations (see offshore description above).
	Demersal Fish (including site attached fish): Lethal and sublethal impact may occur for demersal fish populations (see offshore description above) may result in located medium/long term impacts.
	Resident Fish: Site-attached fish (for example coral reef fish), are at higher risk from hydrocarbon exposure than non-resident, more wide-ranging fish species (see submerged shoal description above).
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, transporting them to the sea surface. As a result, the low sensitivity benthic communities associated with the unconsolidated, soft sediment habitat and any epifauna (filter feeders) associated with the consolidated sediment habitat within and outside the Permit Area are not expected to have widespread exposure to released hydrocarbons. A localised area relating to the hydrocarbon plume at the point of release is predicted, which would result in a small area of seabed and associated epifauna and infauna exposed to hydrocarbons. Evidence from the Deepwater Horizon spill in the Gulf of Mexico recorded low taxa richness and high nematode/harpacticoid-copepod ratios within 3 km of the release location and moderate impacts up to 17 km away. The communities were likely exposed to dispersed hydrocarbons as the response included subsea dispersant application. A loss in benthic biodiversity has been correlated to a decline in deep-water ecosystem functioning. The location of the petroleum activity and the ZoC largely affect continental shelf waters, which are shallower than the Deepwater Horizon spill and as such may host more diverse infauna communities although the impacts are considered to be similar. Therefore, a loss of well containment may result in localised but long-term effects on community structure.
	Open Water – Productivity/Upwelling: Primary production by plankton (triggered by sporadic upwelling events in the offshore waters of the NWS) is an important component of the primary marine

	food web. Planktonic communities are generally mixed including phytoplankton (cyanobacteria and other microalgae) and secondary consuming zooplankton (crustaceans (e.g. copepods), and the eggs and larvae of fish and invertebrates (meroplankton). Exposure to hydrocarbons in the water column can result in changes in species composition with declines or increases in one or more species or taxonomic groups. Phytoplankton may also experience decreased rates of photosynthesis. 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. Therefore, any impacts are likely to be on exposed planktonic communities present in the ZoC and temporary.
	Open Water – Physical Displacement of Fauna from Gas Plume: The effect of the physical extent of the gas plume in the environment is expected to have a limited and localised effect on identified receptors such as the physical barrier created by the gas plume, which may cause the displacement of transient and/or mobile biota such as pelagic fish, megafauna species (migratory whales) and plankton. It is acknowledged that the physical extent of the plume may displace some open water species transiting the offshore waters of this area of the NWS. The extent of the plume is relatively small in comparison to the surrounding offshore environment but the overall impact to the in-water biota and the marine environment in general is expected to be slight to minor short-term impact to communities present in the ZoC.
Submerged Shoals	**Open Water – Productivity/Upwelling**: The submerged shoals of Rankin Bank and Rowley Shoals are areas associated with sporadic upwelling and associated primary productivity events. Spill model results predict entrained hydrocarbons (at or above the 500 ppb threshold) may reach these areas. Therefore, impacts to plankton communities may result in short-term changes in plankton community composition but recovery would occur (see offshore description above). Hydrocarbon contact during the spawning seasons for resident shoal community benthos and fish (meroplankton), particularly exposure to in-water toxicity effects to biota, may result in the loss of a discrete cohort population but would not affect the longer-term viability of resident populations. Therefore, any impacts to resident shoal community benthos and fish (meroplankton) are likely to be localised at the shoals and temporary.
	Filter Feeders: Hydrocarbon exposure to offshore filter-feeding communities (e.g. communities around Rankin Bank in water depths between 80–100 m or other locations as identified in **Table 11-7**) may occur depending on the depth of the entrained/dissolved hydrocarbons. Exposure to entrained hydrocarbons aromatic hydrocarbons (≥500 ppb) has potential to result in lethal or sub-lethal toxic effects. Sub-lethal impacts, including mucus production and polyp retraction, have been recorded for gorgonians exposed to hydrocarbon. Any impacts may result in localised long-term effects to community structure and habitat.
Mainland and Islands (Nearshore Waters)	**Open Water – Productivity/Upwelling:** Nearshore waters and adjacent offshore waters surrounding the offshore islands (e.g. Barrow and Montebello Islands) and to the west of the Ningaloo reef system are known locations of seasonal upwelling events and productivity. The seasonal productivity events are critical to krill production, which supports megafauna aggregations such as whale sharks and manta rays in the region. This has the potential to result in lethal and sub-lethal impacts to a certain portion of plankton in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the condensate. However, recovery would occur (see offshore description above). Therefore, any impacts are likely to be on exposed planktonic communities present in the ZoC and temporary.
	Spawning/Nursery Areas: Fish (and other commercially targeted taxa) in their early life stages (eggs, larvae and juveniles) are at their most vulnerable to lethal and sub-lethal impacts from exposure to hydrocarbons, particularly if a spill coincides with spawning seasons or if a spill reaches nursery areas close to the shore (e.g. seagrass and mangroves). Fish spawning (including for commercially targeted species such as snapper and mackerel) occurs in nearshore waters at certain times of the year and nearshore waters are also inhabited by higher numbers of juvenile fishes than offshore waters. Modelling indicated that in the unlikely event of a major spill there is potential for entrained hydrocarbons to occur in the surface water layers above threshold concentrations in nearshore waters including, but not limited to, the Muiron Islands, Ningaloo Coast, Montebello/Barrow/Lowendal Islands Group, Pilbara Southern Islands Groups, Shark Bay and the Abrolhos Islands. This has the potential to result in lethal and sublethal impacts to a certain portion of fish larvae in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. Although there is the potential for spawning/nursery habitat to be impacted (e.g. mangroves and seagrass beds,

<table>
<tr><td></td><td>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 (DWH) spill. Results indicated that there was no change to the juvenile cohorts following the DWH spill. Additionally there were no significant post-spill shifts in community composition and structure, nor were there changes in biodiversity measures. Any impacts to spawning and nursery areas are expected to be minor and short term, as would flow on effects to adult fish stocks into which larvae are recruited.</td></tr>
<tr><td></td><td>Non Biogenic Coral Reefs: The coral communities fringing the offshore Pilbara region (e.g. the Southern Island Group) may be exposed to entrained hydrocarbons (at or above 500 ppb) and consequently exhibit lethal or sub-lethal impacts resulting in partial or total mortality of keystone sessile benthos, particularly, hard corals and thus potential community structural changes to these shallow, nearshore benthic communities may occur. In the event that these reefs are exposed to entrained hydrocarbons, impacts are expected to result in localised long-term effects.</td></tr>
<tr><td></td><td>Filter Feeders: Hydrocarbon exposure to offshore, filter-feeding communities (e.g. deepwater communities of Ningaloo coast and the Muiron Islands in 20–200 m) may occur depending on the depth of the entrained and dissolved aromatic hydrocarbons. See discussion above on potential impacts.</td></tr>
<tr><td></td><td>Sandy Shores / Estuaries / Tributaries / Creeks (Including Mudflats) / Rocky Shores: Shoreline exposure for the upper and lower areas differ, the upper shore has the potential to be exposed to surface slicks, while the lower shore is subjected to dissolved or entrained hydrocarbon.

Shoreline contact by surface hydrocarbons above threshold concentrations are not expected, however, potential impacts may occur due to isolated shoreline accumulation above threshold concentrations (Ningaloo Coast and Shark Bay only) and entrained hydrocarbon contact with shallow, subtidal and intertidal zones of the Ningaloo Coast, Muiron Islands, Montebello/Barrow/ Lowendal Islands Group, the Southern Island Groups, Shark Bay (open ocean) and the Abrolhos Islands. In-water toxicity of the entrained hydrocarbons reaching these shores will determine impacts to the marine organisms, such as sessile barnacle species and/or mobile gastropods and crustaceans such as amphipods. Lethal and sub-lethal impacts may be expected where the entrained hydrocarbon concentration threshold is >500 ppb. Impacts may result in localised changes to the community structure of these shoreline habitats, which would be expected to recover in the medium term (2–5 years).</td></tr>
<tr><td>Indonesia</td><td>Sandy Shores/Estuaries/Tributaries/Creeks (Including Mudflats)/Rocky Shores: The islands of the Lesser Sunda ecoregions have the potential to be contacted by accumulated hydrocarbons above threshold levels. The potential impacts to shoreline habitats are discussed above for Mainland and Islands (nearshore waters) – sandy Shores/Estuaries/Tributaries/Creeks (including mudflats)/Rock Shores.

Prolonged stranding of surface hydrocarbons, particularly for low energy environments such as mudflats may lead to localised changes to the community structure of these shoreline habitats which would be expected to recover in the medium term (2-5 years).</td></tr>
<tr><td>Key Ecological Features</td><td>Key Ecological Features potentially impacted by the hydrocarbon spill from a loss of well integrity event are:
• Exmouth Plateau
• Continental slope demersal fish communities
• Ancient coastline at 125 m depth contour’
• Canyons that link the Cuvier Abyssal Plan with the Cape Range Peninsula
• Commonwealth waters adjacent to Ningaloo Reef
• Mermaid Reef and Commonwealth waters surrounding Rowley Shoals
• Wallaby Saddle
• Western demersal slope and associated fish communities
• Western Rock lobster
• Ancient coastline at 90-120

Although these KEFs are primarily defined by seabed geomorphological features, they are described to identify the potential for increased biological productivity and, therefore, ecological significance.

The consequences of a hydrocarbon spill from a loss of well control event are predicted to result in moderate impacts with values of the KEF areas affected. Potential impacts include: the contamination</td></tr>
</table>

	of sediments, impacts to benthic sediment fauna and associated impacts to demersal fish populations and reduced biodiversity as described above and below). Most of the KEFs within the ZoC have relatively broad-scale distributions and are unlikely to be significantly impacted.
Summary of potential impacts to water quality	
Setting	***Aspect***
Offshore	**Open Water – Water Quality**: Water quality would be affected due to hydrocarbon contamination which is described in terms of the biological effect concentrations. These are defined by the ZoC descriptions for each of, entrained and dissolved hydrocarbon fates and their predicted extent (refer to **Table 11-7**). Furthermore, water quality is predicted to have minor long term and/or significant short term hydrocarbon contamination above background and/or national/international quality standards.
Submerged Shoals	**Open Water – Water Quality:** Water quality would be reduced due to hydrocarbon contamination that is predicted to be at or above biological effect concentrations for the surrounding marine waters over Rankin Bank. The submerged Rankin Bank and Rowley shoals has the potential to be exposed to entrained hydrocarbons at or greater than 500 ppb. The waters surrounding this permanently submerged habitat, would show a reduction in quality due to hydrocarbon contamination above background and/or national/international quality standards.
Mainland and Islands (Nearshore waters)	**Open Water – Water Quality:** Water quality would be affected/reduced due to hydrocarbon contamination, with modelling predictions indicating that hydrocarbon contact is at or above biological effect concentrations for entrained hydrocarbons in nearshore waters of identified islands and the mainland coast (refer to **Table 11-7**). Such reduction in water quality is predicted to have minor long term or significant short term hydrocarbon contamination above background and/or national/international quality standards.
Summary of potential impacts to marine sediment quality	
Setting	***Receptor Group***
Offshore	**Marine Sediment Quality**: In the event of a major hydrocarbon release at the seabed, modelling indicates that a pressurised release of condensate would atomise into droplets that would be rapidly transported into the water column to the surface. As a result, the extent of potential impacts to the seabed area at and surrounding the release site would be confined to a localised footprint. Marine sediment quality would be reduced (contamination above national/international quality standards) as a consequence of hydrocarbon contamination for a small area within the immediate release site for a long to medium term.
Submerged Shoals	**Marine Sediment Quality:** There is potential for the reduction of marine sediment quality due to contact and adherence of entrained hydrocarbons with seabed sediments of the submerged shoals. If this was to occur, marine sediment quality would be reduced (contamination above national/international quality standards) as a consequence of hydrocarbon contamination for a small area within the immediate release site for a long to medium term. However, given the nature of the hydrocarbon, contact with submerged shoals is considered unlikely.
Mainland and Islands (Nearshore waters)	**Marine Sediment Quality:** Entrained hydrocarbons (at or above the defined thresholds) are predicted to potentially contact shallow, nearshore waters of identified islands and mainland coastlines and hydrocarbons may accumulate (at or above the ecological threshold) at the Ningaloo Coast and Shark Bay (refer to **Table 11-7**). Such hydrocarbon contact may lead to reduced marine sediment quality by several processes, such as adherence to sediment and deposition shores or seabed habitat.
Indonesia	**Marine Sediment Quality:** Surface and accumulated hydrocarbons at or above the defined thresholds are predicted to potentially contact shallow, nearshore waters and shorelines within the Lesser Sunda Ecoregions (refer to **Table 11-7**). Such hydrocarbon contact may lead to reduced marine sediment quality by several processes, such as adherence to sediment and deposition shores or seabed habitat. Surface slicks predicted to potentially contact areas of the Ningaloo Coast also have the potential to reduce sediment quality due hydrocarbon contamination above background and/or national/international quality standards for the medium term.
Summary of potential impacts to air quality	
A hydrocarbon release during a loss of well containment has the potential to result in localised, temporary reduction in air quality. Potential impacts are expected to be a slight and temporary localised effect to ecosystems, species and/or habitats in the area. There is potential for human health effects for workers in the immediate vicinity of atmospheric emissions. The	

ambient concentrations of methane and volatile organic carbons (VOCs) released from diffuse sources is difficult to accurately quantify, although their behaviour and fate is predictable in open offshore environments as it is dispersed rapidly by meteorological factors such as wind and temperature. Methane and VOC emissions from a hydrocarbon release in such environments are rapidly degraded in the atmosphere by reaction with photo chemically-produced hydroxyl radicals. Due to the unlikely occurrence of a loss of well containment; the temporary nature of any methane or VOC emissions (from either gas surfacing or weathering of liquid hydrocarbons from a loss of well containment); the predicted behaviour and fate of methane and VOCs in open offshore environments; and the significant distance from the Permit Area to the nearest sensitive air shed (town of Dampier approximately 257 km away), the potential impacts are expected to be minor and temporary.	
Summary of potential impacts to protected areas	
The quantitative spill risk assessment results indicate that the open water environment protected within the Commonwealth Marine Reserves listed in **Table 11-7** may be affected by the released hydrocarbons. In the unlikely event of a major spill and entrained hydrocarbons and/or dissolved hydrocarbons may contact the identified key receptor locations of islands and mainland coastlines resulting in the actual or perceived contamination of protected areas, including the Ningaloo WHA and the Ningaloo Commonwealth and State Marine reserves, as identified for the ZoC (refer to **Table 11-7**). Objectives in the Ningaloo Marine Park (Commonwealth Waters) Management Plan and the Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area require considerations to a number of physical, ecological and social values identified in these areas. Impact on the values of this protected area is discussed in the relevant sections above for ecological and physical (water quality) values and below for social (socio-economic) values. There is also the potential for the following Indonesian Marine National Parks and National Parks to be contact by accumulated hydrocarbons at or above threshold levels: • Laut Sawu Marine National Park; • Manupeu Tanadaru National Park; • Laiwangi Wanggameti National Park; • Savu Sea National Marine Conservation Area and • Komodo National Park. Impact on the protected areas is discussed in the sections above for ecological the values and sensitivities and below for socio-economic values. Additionally, such hydrocarbon contact may alter stakeholder understanding and/or perception of the protected marine environment, given these represent areas largely unaffected by anthropogenic influences and contain biological diverse environments.	
Summary of potential impacts to socio-economic values	
Setting	**Receptor Group**
Offshore	**Fisheries - Commercial:** Spill scenarios modelled are unlikely to cause significant direct impacts on the target species of Commonwealth and offshore State fisheries within the defined ZoC. Further details are provided below (impact assessment relating to spawning is discusses above under 'Summary of potential impacts to other habitats and communities'). *Western Tuna and Billfish, Southern Bluefin Tuna, Western Skipjack Fishery and West Australian Mackerel Fisheries:* The tuna fisheries (Western Tuna and Billfish, Western Skipjack Fishery Southern Bluefin Tuna fisheries for which limited fishing activity has occurred in this area in recent years) and the Western Australian Mackerel fishery target pelagic fish species. Adult fish are highly mobile and able to move away from the spill affected area or avoid the surface waters; however, hydrocarbon concentrations in the upper water column could lead to potential exposure through direct absorption of hydrocarbons and indirectly by the consumption of contaminated prey. Given these pelagic species are distributed over a wide geographical area, the impacts at the population or species level are considered minor in the unlikely event of a spill. *Western Deep Trawl and Northwest Slope Trawl Fisheries:* The predicted ZoC resulting from an uncontrolled loss of hydrocarbon from a well blowout may result in direct impacts on the species fished by the Northwest Slope Trawl Fishery and Western Deep Trawl Fishery. These fisheries target benthic species (demersal finfish and crustaceans) in greater than 200 m water depth. The Northwest Slope Trawl fishery targets scampi and deepwater prawns, these species are less mobile and will therefore not be able to easily move away from the location of a well blowout. Mortality/sub lethal

	effects may impact populations located close to the well blowout location. While the Western Deep Trawl fishery targets over 50+ demersal fish species. Mortality and sub lethal effects may impact localised populations of targeted species located close to the well blow out and within the ZoC for entrained/dissolved hydrocarbons (≥500 ppb). However, the entrained hydrocarbon is likely to be confined in the upper water column and therefore the demersal species are less likely to be exposed to hydrocarbons than pelagic species. This is particularly relevant as the majority of the fishing effort for both these fisheries is located distant from the location of a potential well blowout, fish resources exploited by these fisheries are unlikely to be impacted significantly as hydrocarbons at this distance are likely to be confined in the upper water column. A major loss of hydrocarbons from the Petroleum Activities Program may lead to an exclusion of fishing from the spill affected area for an extended period. *State Fisheries*: The predicted ZoC resulting from a major spill may impact on the area fished by a number of State fisheries. These fisheries generally use a range of gear types (trawl, trap and line) and operate from shallow inshore water to water depths up to 200 m, targeting demersal and pelagic finfish species and prawns. In the unlikely event of a major hydrocarbon spill, there is the potential for the targeted fish species to be exposed to entrained and/or dissolved aromatic hydrocarbons in the water column. However, the potential for direct impact would be reduced as target species such as mackerel and snapper are likely to avoid the surface water layer underneath oil slicks. Demersal species (such as finfish and crustaceans) have limited mobility and therefore, will not be able to easily move away from a spill. Mortality/sub lethal effects may impact populations located close to the well blowout location. A major loss of hydrocarbons from the Petroleum Activities Program may lead to an exclusion of fishing from the spill affected area for an extended period. A number of other State and Commonwealth fisheries, further afield in the ZoC, may also be affected by a major spill, however, the impacts to these far field fisheries will be similar to that described below for ‘General Fisheries Impacts’. *General Fisheries Impacts:* Fish exposure to hydrocarbon can result in ‘tainting’ of their tissues. Even very low levels of hydrocarbons can impart a taint or ‘off’ flavour or smell in seafood. Tainting is reversible through the process of depuration which removes hydrocarbons from tissues by metabolic processes, although it is dependent upon the magnitude of the hydrocarbon contamination. Fish have a high capacity to metabolise these hydrocarbons while crustaceans (such as prawns) have a reduced ability. Seafood safety is a major concern associated with spill incidents. Therefore, actual or potential contamination of seafood can affect commercial and recreational fishing, and can impact seafood markets long after any actual risk to seafood from a spill has subsided. A major spill would result in the establishment of an exclusion zone around the spill affected area. There would be a temporary prohibition on fishing activities for a period of time and subsequent potential for economic impacts to affected commercial fishing operators.
	Tourism including Recreational Activities: Recreational fishers predominantly target tropical species, such as emperor, snapper, grouper, mackerel, trevally and other game fish. Recreational angling activities include shore-based fishing, private boat and charter boat fishing, with the peak in activity between April and October. Limited recreational fishing takes place in the offshore waters of the Permit Area. Impacts on species that are recreationally fished are described above and under ‘Summary of potential impacts to other species’ above. A major loss of hydrocarbon from the Petroleum Activities Program may lead to exclusion of marine nature-based tourist activities, resulting in a loss of revenue for operators.
	Offshore Oil and Gas Infrastructure: In the unlikely event of a major spill, surface hydrocarbons may affect production from existing petroleum facilities (platforms and FPSOs). For example, facility water intakes for cooling and fire hydrants could be shut off which could in turn lead to the temporary cessation of production activities. Spill exclusion zones established to manage the spill could also prohibit support vessel access as well as offtake tankers approaching facilities off the North West Cape. The impact on ongoing operations of regional production facilities would be determined by the nature and scale of the spill and metocean conditions. Furthermore, decisions on the operation of production facilities in the event of a spill would be based primarily on health and safety considerations. The closest production is the Wheatstone Platform (operated by Chevron). Other nearby facilities include the Woodside operated Pluto Platform. Operation of these facilities is likely to be affected in the event of a well blow-out spill.
Submerged shoals	**Tourism and Recreation:** In the unlikely event of a major spill a temporary prohibition on charter boat recreational fishing trips and any other marine nature-based tourism trips to Rankin Bank and Rowley Shoals may be put into effect, depending on the trajectory of the plume, resulting in a loss of revenue for operators.

Mainland and Islands (Nearshore Waters)	**Fisheries - Commercial:** *Nearshore Fisheries and Aquaculture:* In the unlikely event of a loss of well containment, there is the possibility that target species in some areas utilised by a number of state fisheries, prawn fisheries and pearl oyster fisheries in nearshore waters of the Montebello Islands, Exmouth Gulf and Shark Bay, and aquarium fisheries in the nearshore waters that are within the ZoC could be affected. Targeted fish, prawn, mollusc and lobster species and pearl oysters could experience sub-lethal stress, or in some instances, mortality depending on the concentration and duration of hydrocarbon exposure and its inherent toxicity. *Prawn Managed Fisheries:* In the event of a major spill, the modelling indicated the entrained ZoC may extend to nearshore waters closest to the mainland Pilbara and Gascoyne coasts, including the actively fished areas of the designated Onslow Prawn Managed Fishery, Exmouth Gulf Prawn managed Fishery, Nickol Bay Prawn Managed Fishery, Broome Prawn Managed Fishery and the Shark Bay Prawn and Scallop Managed Fishery, and managed prawn nursery areas. Note that the majority of the demarcated area for the prawn managed fishery in the Exmouth Gulf (proper) is outside the ZoC. Prawn habitat utilisation differs between species in the post-larval, juvenile and adult stages and direct impacts to benthic habitat due to a major spill has the potential to impact prawn stocks. For example, juvenile banana prawns are found almost exclusively in mangrove-lined creeks (, whereas juvenile tiger prawns are most abundant in areas of seagrass. Adult prawns also inhabit coastline areas but tend to move to deeper waters to spawn. In the event of a major spill, the model predicted shallow subtidal and intertidal habitats at the Muiron Islands, Montebello Islands, Barrow Island, Lowendal Islands, Pilbara Southern Island Groups, Exmouth Gulf, Shark Bay (open ocean coast), and mangrove and seagrass habitats of the Ningaloo Coast are located within the ZoC and could be exposed to hydrocarbon concentrations above threshold concentrations, depending on the trajectory of the plume. Localised loss of juvenile prawns in worse spill affected areas is possible. Whether lethal or sub-lethal effects occur will depend on duration of exposure, hydrocarbon concentration and weathering stage of the hydrocarbon and its inherent toxicity. Furthermore, seafood consumption safety concerns and a temporary prohibition on fishing activities may lead to subsequent potential for economic impacts to affected commercial fishing operators.
	Fisheries – traditional: Although no designated traditional fisheries have been identified it is recognised that indigenous communities fish in the shallow coastal and nearshore waters of Barrow Island, Montebello Islands and Ningaloo Reef, and therefore may be potentially impacted if a hydrocarbon spill from a loss of well containment were to occur. Impacts would be similar to those identified for commercial fishing in the form of a potential exclusion zone and contamination/tainting of fish stocks.
	Tourism and Recreation: In the unlikely event of a major spill, the nearshore waters of island groups including the Muiron Islands, Barrow/Lowendal/Montebellos and the Pilbara islands (Southern Island groups) and mainland coasts (Ningaloo and Shark Bay), could be reached by entrained hydrocarbon, depending on prevailing wind and current conditions. Shoreline accumulation above threshold concentrations is also predicted for the Ningaloo Coast and Shark Bay. These locations offer a number of amenities such as fishing, swimming and utilisation of beaches and surrounds have a recreational value for local residents and visitors (regional, national and international). If a major spill resulted in hydrocarbon contact, there could be restricted access to beaches for a period of days to weeks, until natural weathering or tides and currents remove the hydrocarbons. In the event of a major spill, tourists and recreational users may also avoid areas due to perceived impacts, including after the hydrocarbon spill has dispersed. There is potential for stakeholder perception that this remote environment will be contaminated over a large area and for the longer term resulting in a prolonged period of tourism decline. Oxford Economics (2010) assessed the duration of hydrocarbon spill related tourism impacts and found that on average, it took 12 to 28 months to return to baseline visitor spending. There is likely to be significant impacts to the tourism industry, wider service industry (hotels, restaurants and their supply chain) and local communities in terms of economic loss as a result of spill impacts to tourism. Recovery and return of tourism to pre-spill levels will depend on the size of the spill, effectiveness of the spill clean-up and change in any public misconceptions regarding the spill.
	Cultural Heritage: There are a number of historic shipwrecks identified, with the closest to the Permit Area being the *Curlew Marietta, Vianen and Wildwave*, located approximately 82 km away in the Montebellos Area. The modelling results do not predict surface slicks contacting the identified wrecks, and entrained hydrocarbons are predicted to be confined to the upper 40 m of the water column, with the majority of entrained hydrocarbons occurring close to the surface. However, shipwrecks occurring in the subtidal zone will be exposed to entrained and dissolved hydrocarbons and marine life that shelter and take refuge in and around these wrecks may be affected by in-water toxicity of dispersed hydrocarbons, The consequences of such hydrocarbon exposure may include all or some of the

	following: large fish species moving away and/or resident fish species and sessile benthos such as hard corals exhibiting sub-lethal and lethal impacts (which may range from physiological issues to mortality). Accumulated hydrocarbons above threshold concentrations (> 100 g/m^2) are predicted at Ningaloo Coast. It is acknowledged that the area contains numerous Indigenous sites such as burial grounds, middens and fish traps that provide a historical account of the early habitation of the area and a tangible part of the culture of local Indigenous groups (CALM, 1990). Additionally, artefacts, scatter and rock shelter are contained on Barrow and Montebello islands (no contact by surface hydrocarbons or accumulated hydrocarbons predicted for these areas). Within the wider ZoC a number of places are designated on the National Heritage List. These places are also covered by other designations such as WHA, marine parks, listed shipwrecks. Potential impacts have, therefore been discussed in the sections above.

Summary of Potential Impacts to environmental values(s)

In the unlikely event of a major hydrocarbon spill due to a loss of well integrity, the ZoC includes the areas listed in **Table 11-7**, including but not limited to, the sensitive marine environments and associated receptors of the Muiron Islands, Ningaloo Coast, Exmouth Gulf, Rankin Bank, Rowley Shoals, Montebello/Barrow/Lowendal Islands Group, the Pilbara Southern Islands Groups, Shark Bay, and the Abrolhos Islands and any sensitive receptors in the open waters amongst these key receptor locations. In summary, long term impacts may occur at sensitive nearshore and shoreline habitats, particularly, areas of the Ningaloo Coast, as a result of a major spill of hydrocarbon from drilling activities within the Permit Area.

The overall environmental consequence is defined as B 'Major, long term impact (10-50 years) on highly valued ecosystem, species, habitat, physical or biological attributes'. The likelihood of the event is defined as a '1' Highly Unlikely' resulting in a risk ranking of high.

Summary of Controls

- Accepted Well Operations Management Plan (WOMP) and application to drill;
- Regulatory scrutiny and acceptance of the Well Operations Management Plan (WOMP), which describes the well design and barriers to be used to prevent a loss of well control;
- Woodside's Well Acceptance Criteria Procedure details the as-built checks that shall be completed during well operations to establish a minimum acceptable standard of well integrity is achieved;
- Woodside Suspension and Abandonment Procedure;
- Woodside Well Blowout Contingency Planning Procedure details specifications for well design to assess the feasibility of performing a well kill operation;
- Subsea BOP specification and function testing is undertaken in accordance with internal Woodside Standards and international requirements;
- For high pressure/high temperature wells undertake risk assessment prior to drilling the bottom hole section, during cyclone season; and
- Mitigation: Oil spill response

Accidental Hydrocarbon Release: Vessel Collision

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Loss of hydrocarbons to marine environment due to a vessel collision (e.g. support vessels or other marine users).			X		X	X	X	D	1	M

Description of Source of Risk

Background

The MODU has a total marine diesel capacity of approximately 966 – 1400 m^3 that is distributed through a number of isolated tanks. MODU fuel tanks are located in the MODU pontoons, typically located on the inner sides of pontoons and can be over 10 m below the waterline.

The marine diesel storage capacity of a support vessel can also be in the order of 1000 m^3 (total) that is distributed through multiple isolated tanks typically located mid-ships and can range in typical size from 22 to105 m^3.

A typical ISV vessel is likely to have multiple isolated fuel tanks distributed throughout the hull of the vessel. Individual fuel tanks are typically 500 m^3 in volume. In the unlikely event of a vessel collision involving an ISV during the Petroleum Activities Program, the vessels will have the capability to pump fuel from a ruptured tank to a tank with spare volume in order to reduce the potential volume of fuel released to the environment.

There will be at least one support vessel on standby at all times with the MODU. This temporary presence in the area will result in a navigational hazard for commercial shipping within the immediate area. This navigational hazard could result in a third party vessel colliding with the MODU which could result in a loss of well containment.

Industry Experience

Registered vessels or foreign flag vessels in Australian waters are required to report events to the Australian Transport Safety Bureau (ATSB), AMSA or Australian Search and Rescue (AusSAR).

From a review of the ATSB marine safety and investigation reports, one vessel collision occurred in 2011-12 that resulted in a spill of 25-30 L of oil into the marine environment as a result of a collision between a tug and support vessel off Barrow Island. Two other vessel collisions occurred in 2010, one in the port of Dampier, where a support vessel collided with a barge being towed. Minor damage was reported and no significant injury to personnel or pollution occurred. The second 2010 vessel collision involved a vessel under pilot control in port connected with a vessel alongside a wharf causing it to sink. No reported pollution resulted from the sunken vessel. These incidents demonstrate the likelihood of only minor volumes of hydrocarbons being released during the highly unlikely event of a vessel collision occurring.

From 2010 to 2011, the ATSB's annual publication defines the individual safety action factors identified in marine accidents and incidents: 42% related to navigation action. Of those, 15% related to poor communication and 42% related to poor monitoring, checking and documentation. The majority of these related to the grounding instances.

Credible Scenario

For a vessel collision to result in the worst-case scenario of a hydrocarbon spill potentially impacting an environmental receptor, several factors must align as follows:

- the identified causes of vessel interaction must result in a collision;
- the collision must have enough force to penetrate the vessel hull;
- the collision must be in the exact location of the fuel tank; and
- the fuel tank must be full, or at least of volume which is higher than the point of penetration.

The probability of the chain of events described above aligning, to result in a breach of fuel tanks resulting in a spill that could potentially affect the marine environment is considered remote. Given the offshore location of the Permit Area, vessel grounding is not considered a credible risk.

The environmental risk analysis and evaluation undertaken identified and assessed a range of potential scenarios that could result in a loss of vessel structural integrity resulting in damage to fuel storage tank(s) and a loss of marine diesel to the marine environment (**Table 11-8**). The scenarios considered damage to single and multiple fuel storage tanks in the support vessel, ISV and MODU due to dropped objects and various combinations of vessel to vessel and vessel to MODU collisions. In summary:

1. It is not a credible scenario that the total storage volume of the MODU would be lost, as fuel is stored in more than one tank.
2. It is not a credible scenario that a storage tank on the MODU would be damaged due to the location of the tanks within the hull, behind the bilge tanks, below the waterline.
3. It is not a credible scenario that a collision between the support vessel and MODU would damage any storage tanks, due to the location of the tanks on both vessel types, and secondary containment.
4. It is highly unlikely that the full volume of the largest storage tank on a support vessel or ISV would be lost.

The last scenario considered was a collision between the support vessel or ISV with a third party vessel (i.e. commercial shipping, other petroleum related vessels and commercial fishing vessels). This was assessed as being credible but highly unlikely given the distance of the Permit Area from the nearest shipping fairway approximately 40 km away) standard vessel operations and equipment in place to prevent collision at sea, the short duration of ISV operations on the Permit Area, the standby role of a support vessel (low vessel speed) and its operation in close proximity to the MODU (exclusion areas) and the construction and placement of storage tanks. The largest tank of the support vessel is unlikely to exceed 105 m^3; the largest tank volume of an ISV is unlikely to exceed 500 m^3.

Table 11-8: Summary of credible hydrocarbon spill scenario as a result of vessel collision

Scenario	Hydrocarbon Volumes	Preventative and Mitigation Controls	Credibility	Max. Possible Volume loss (m^3)
Breach of MODU fuel tanks due to support vessel collision.	MODU has a fuel oil storage capacity of approximately 966 - 1400 m^3, distributed through multiple tanks.	Fuel tanks are located on the inside of pontoons and protected by location below water line, protection from other tanks e.g. bilge tanks. The draught of vessel and location of tanks in terms of water line prevent the tanks from being breached.	**Not credible** Due to location of tanks	0
Breach of support vessel fuel tanks due to collision with MODU.	Activity support vessel has multiple marine diesel tanks typically ranging between 22-105 m^3 each.	Typically double wall tanks, which are located mid ship (not bow or stern). Slow support vessel speeds when in close proximity to MODU.	**Not credible** Collision with MODU at slow speeds is highly unlikely and if did occur is highly unlikely to result in a breach of support vessel (low energy contact from slow moving vessel).	0
Breach of installation support vessel fuel tanks during CAN installation due to collision with third party vessel, including commercial shipping and fishing.	ISV support vessel has multiple isolated tanks; largest volume of a single tank is likely to be < 500 m^3	Tank locations midship (not bow or stern). For the majority of CAN installation, the vessel will be holding location.	**Credible** Installation vessel – third party vessel collision could potentially result in the release form a fuel tank	500 m^3 (volume for modelling)

Breach of support vessel fuel tanks due to support vessel - other vessel collision including commercial shipping/ fisheries	Activity support vessel has multiple marine diesel tanks typically ranging between 22-105 m^3 each.	Typically double wall, tanks which are located midship (not bow or stern) Vessels are not anchored and steam at low speeds when relocating within the Permit Area or providing stand-by cover. Normal maritime procedures would apply during such vessel movements	**Credible** Activity support vessel – other vessel collision could potentially result in the release from a fuel tank	105 m^3– note the assessment of the 500 m^3 release from ISV scenario has been used as a surrogate for this scenario.
Loss of well control due to third party vessel (e.g. large bulk carrier) collision with MODU during drilling activities	Loss of containment of reservoir fluids – see **Section 5.7.2** for estimated volumes	Refer to **5.6.1** for preventative and mitigation controls	**Not credible** The Permit Area is distant from the nearest shipping fairway (approximately 40 km away).	0
Dropped object from back-loading/ offloading operations rupturing the MODU fuel tanks (e.g. a container or piece of equipment)	MODU has a fuel oil storage capacity of approximately 966-1400 m^3, distributed through multiple tanks	Fuel tanks are located on the inside of pontoons and protected by location below water line, protection from other tanks e.g. bilge tanks The draught of vessel and location of tanks in terms of water line prevent the tanks from being breached.	**Not credible** No direct pathway to tanks from dropped objects.	0

Quantitative Hydrocarbon Risk Assessment

Modelling was undertaken by RPS APASA, on behalf of Woodside, to determine the fate of marine diesel released from a collision at a location within the Permit Area. The modelling assessed the extent of marine diesel spill volume of 500 m^3 for all seasons, using an historic sample of wind and current data for the region. A total of 100 simulations for each season were modelled, with each simulation tracked for 42 days.

Hydrocarbon characteristics

Marine diesel is a mixture of both volatile and persistent hydrocarbons. Predicted weathering of marine diesel, based on typical conditions in the region, indicates that approximately 50% by mass would be expected to evaporate over the first day or two (**Figure 11-2**). After this time the majority of the remaining hydrocarbon is entrained into the upper water column. In calm conditions entrained hydrocarbons are likely to resurface. Up to 95% of the spill volume is expected to evaporate over time (**Figure 11-2**). The remaining 5% is persistent and will reduce in concentration through degradation and dissolution.

Given the environmental conditions experienced in the Permit Area, marine diesel is expected to undergo rapid spreading and this, together with evaporative loss, is likely to result in a rapid dissipation of the spill. Marine diesel distillates tend not to form emulsions at the temperatures found in the region. Therefore, there is no potential for the spill to extend to sensitive shorelines or mainland receptors above threshold concentrations. The characteristics of the marine diesel used in the modelling are given in **Table 11-9**.

Table 11-9: Characteristics of the marine diesel used in the modelling

Hydrocarbon Type	Initial Density (g/cm^3) at	Viscosity (cP @ 25˚C)	Component BP (˚C)	Volatiles <180	Semi volatiles 180-265	Low Volatility (%) 265-380	Residual (%) >380

	25˚C			Non-Persistent			Persistent
Marine Diesel (surrogate for marine gas oil – MGO)	0.829	4.0	% of total	6	34.6	54.4	5

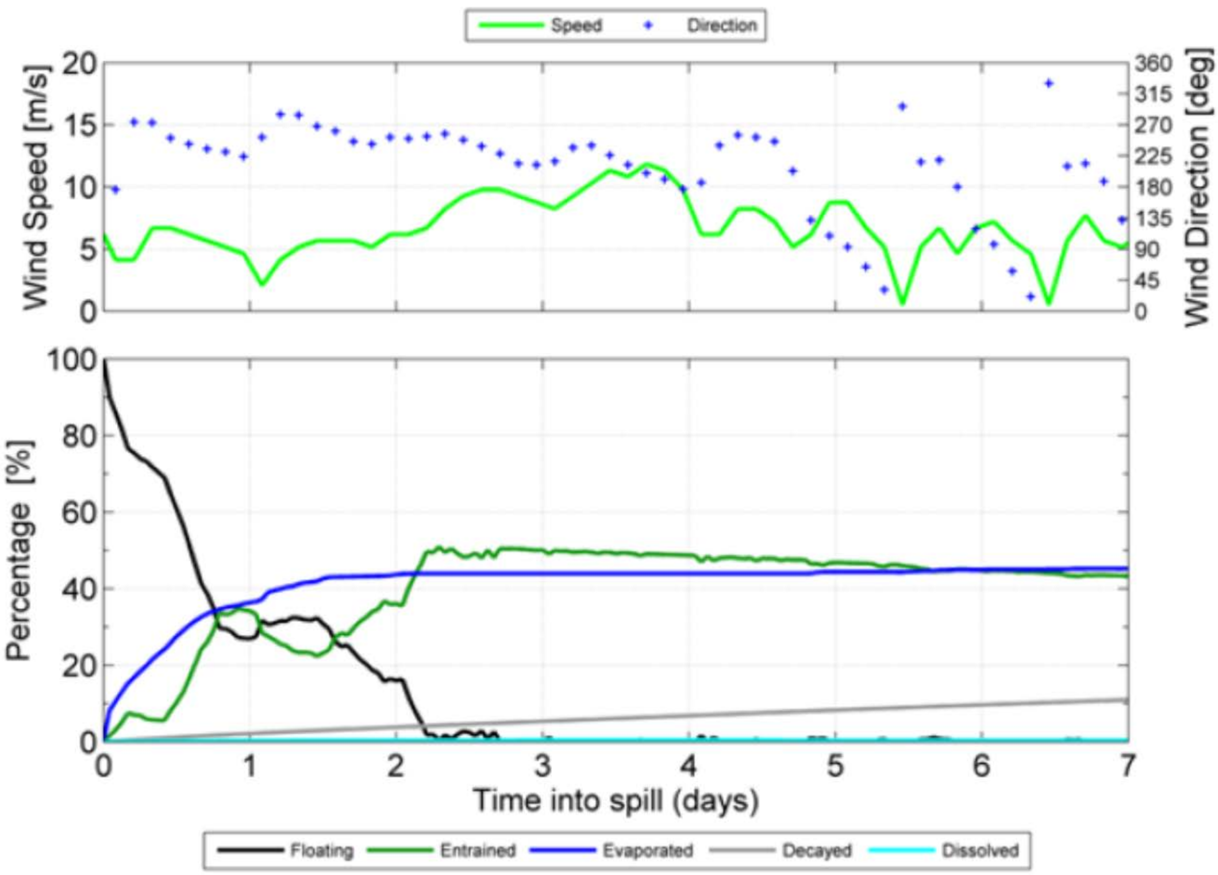

Figure 11-2: Proportional mass balance plot representing weathering of a surface spill of marine diesel as a one-off release (50 m^3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Impact Assessment

Potential Impacts Overview

Zone of Consequence

Surface hydrocarbons: In the event that this scenario occurred, a surface hydrocarbon slick would form down current of the release location with the trajectory dependent on prevailing wind and current conditions at the time. The modelling indicates that the ZoC would be confined to open water, with floating oil extending up to approximately 100 km from the release location above 10 g/m^2 impact threshold.

Entrained hydrocarbons: In the event that this vessel collision scenario occurred, a plume of entrained hydrocarbons would form down current of the release location with the trajectory dependent on prevailing current conditions at the time. The modelling indicates locations within reach of entrained hydrocarbon ZoC to threshold concentrations are restricted to offshore areas up to approximately 60 km from the release site.

Dissolved hydrocarbons: Dissolved hydrocarbons above threshold concentrations (>500 ppb) were not predicted by the modelling to occur at any location. Therefore, no contact with any sensitive receptors is predicted, and a ZoC figure is not presented.

Accumulated hydrocarbons: Accumulated hydrocarbons above threshold concentrations (>100 g/m^2) were not predicted by the modelling to occur at any location.

Summary of potential impacts

In the unlikely event of a spill of marine diesel as a result of vessel collision, the ZoC is expected to remain small and localised, restricted to the open ocean only (Commonwealth waters). Consequently, a ZoC summary table has not been presented.

Potential impacts to protected species, other habitats and communities, water quality, protected areas and socio-economic sensitivities

The potential biological and ecological impacts associated with hydrocarbon spills are presented in the risk assessment for a loss of well containment above. Further detail on impacts specific to a spill of marine diesel are provided below. It is noted that the toxic components in marine diesel include alkylated naphthalenes which can be rapidly accumulated by marine biota including invertebrates such as marine oysters, clams, shrimp, as well as a range of vertebrates, such as finfish. Marine diesel also contains additives that contribute to its toxicity.

Protected Species

Protected species, including pygmy blue whales and marine turtles may be encountered within the Permit Area and therefore, could be impacted by a marine diesel spill. No critical habitats or aggregation areas (feeding, breeding, resting) have been identified within the ZoC. Although the ZoC may spatially overlap with BIAs, it is considered that protected species that are present will be predominantly transiting through the area. In the event that marine fauna come into contact with a release, they could suffer fouling, ingestion, inhalation of toxic vapours, irritation of sensitive membranes in the eyes, mouth, digestive and respiratory tracts and organ or neurological damage. Given the localised area of the potential ZoC and the dilution and weathering of any spill, the likelihood of ecological impacts to marine fauna (protected species), it is expected that any potential impacts will be low magnitude and temporary in nature.

Other Habitats, Species and Communities

Within the ZoC for a marine diesel spill resulting from a vessel collision, there is the potential for plankton communities to potentially be impacted where entrained hydrocarbon threshold concentrations are exceeded. Communities are expected to recover quickly (weeks/months) due to high population turnover. With the relatively small ZoC and the fast population turn-over of open water plankton populations, it is considered that any potential impacts would be low magnitude and temporary in nature.

Pelagic fish populations in the open water offshore environment of the ZoC are highly mobile and have the ability to move away from a marine diesel spill. The spill affected area would likely be confined to the upper surface layers. It is therefore unlikely that fish populations would be exposed to widespread hydrocarbon contamination. Fish populations are likely to be distributed over a wide geographical area so impacts on populations or species level are considered to be negligible. Combined with these factors, the relatively small ZoC and the rapid dispersion of marine diesel, it is considered that any potential impacts will be negligible. While other communities (e.g. demersal fish, benthic infauna and epifauna) and key sensitivities (e.g. KEFs) may be within the ZoC, they are unlikely to be directly impacted by a marine diesel spill as hydrocarbons are confined to the top 40 m of the water column.

Water Quality

It is likely that water quality will be reduced at the release location of the spill; however, such impacts to water quality would be temporary and highly localised in nature due to the relatively localised ZoC and the rapid dispersion of marine diesel. The potential impact is therefore expected to be low.

Protected areas

Entrained and dissolved hydrocarbons (at or exceeding thresholds) are not predicted to contact any protected area.

Socio-economic

A marine diesel spill is considered unlikely to cause significant direct impacts on the target species fished by the Commonwealth and State Fisheries which overlap with the ZoC. These fisheries target demersal fish species (demersal finfish and crustaceans) that inhabit waters in the range of >60–200 m depth or pelagic species which are highly mobile. Therefore, a marine diesel spill due is expected to only result in negligible impacts, considering the relatively small area of the ZoC and hydrocarbons are confined to the top 40 m of the water column. However, there is the potential that a fishing exclusion zone would be applied in the area of the spill, which would put a temporary ban on fishing activities and therefore potentially lead to subsequent economic impacts on commercial fishing operators if they were planning on undertaking fishing within the area of the spill.

Summary of Potential Impacts to environmental values(s)

In the unlikely event of an unplanned hydrocarbon release to the marine environment due to vessel collision, combined with the adopted controls, it is considered that any potential impact would be localised, low and temporary in nature to water quality in comparison to background levels and/or international standards with localised, low and temporary impacts to habitats, populations and shipping/fishing concerns.

The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to vessel collision is defined as E, which equates to 'Slight, short-term impact (<1 year) on

species, habitat (but not affecting ecosystem function), physical or biological attributes'.
Summary of Controls
• Marine Orders 30 (Prevention of Collisions) 2009; • Marine Order 21 (Safety of navigation and emergency procedures) 2012; • Establishment of a 500 m petroleum safety zone around MODU and ISV (during CAN installation) and communicated to marine users; • A support vessel is on standby during drilling activities to communicate with third-party vessels and assist in maintaining the petroleum safety zone; • The support vessel will comply with the Woodside Marine Charterers Instructions to prevent unplanned interactions; • Notify Australian Hydrographic Service (AHS) of activities and movements prior to the activities commencing; and • Mitigation: Oil spill response.

Accidental Hydrocarbon Release: Bunkering

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Loss of hydrocarbons to marine environment from bunkering / refuelling.			X			X		F	2	L

Description of Source of Risk

Bunkering of marine diesel between the support vessel/s and the MODU or ISV occurs at the drilling location. Additionally, refuelling of helicopters using aviation jet fuel may take place onboard the MODU.

Three credible scenarios for the loss of containment of marine diesel during bunkering operations were identified:

- partial or total failure of a bulk transfer hose or fittings during bunkering, due to operational stress or other integrity issues could spill marine diesel to the deck and/or into the marine environment. This would be in the order of less than 200 L, based on the likely volume of a bulk transfer hose (assuming a failure of the dry break coupling and complete loss of hose volume).
- partial or total failure of a bulk transfer hose or fittings during bunkering, combined with a failure in procedure to shutoff fuel pumps, for a period of up to five minutes, resulting in approximately 8 m^3 marine diesel loss to the deck and/or into the marine environment.
- partial or total failure of a bulk transfer hose or fittings during helicopter refuelling could spill aviation jet fuel to the helicopter deck and/or into the marine environment. All helicopter refuelling activities are closely supervised and leaks on the helideck are considered to be easily detectable. In the event of a leak, transfer would cease immediately. The credible volume of such a release during helicopter refuelling would be in the order of <100L.

Quantitative Spill Risk Assessment

Given the physical and chemical similarities, and the relatively small credible spill volumes, marine diesel is considered to be a suitable substitute for aviation jet fuel for the purposes of this environmental risk assessment. Woodside has commissioned RPS APASA to model several small marine diesel spills, including surface spill volumes of 8 m^3 in the offshore waters of northwest WA. The results of these models have indicated that exposure to surface hydrocarbons above the 10 g/m^2 threshold is limited to the immediate vicinity of the release site, with little potential to extend beyond 1 km. Therefore, it is considered that exposure to thresholds concentrations from an 8 m^3 surface spill from bunkering activities would be well within the ZoC for the vessel collision scenario detailed in the risk assessment for a hydrocarbon spill from a vessel collision. Given this, the offshore location of the Permit Area, and the fact that the same hydrocarbon type is involved for both scenarios, specific modelling for an 8 m^3 marine diesel release was not undertaken for this Petroleum Activities Program.

Hydrocarbon Characteristics

Refer to the risk assessment for a hydrocarbon spill from a vessel collision for a description of the characteristics of marine diesel, including detail on the predicted fate and weathering of a spill to the marine environment.

Impact Assessment

Potential Impacts Overview

Previous modelling studies for 8 m^3 marine diesel releases, spilled at the surface as result of bunkering activities, indicated that the potential for exposure to surface hydrocarbons exceeding 10 g/m^2 was confined to within the immediate vicinity (approximately 1 km) of the release sites. Therefore, it is considered that there is no potential for contact with sensitive receptor locations above surface (10 g/m^2), entrained (500 ppb) or dissolved (500 ppb) threshold concentrations from an 8 m^3 spill of marine diesel within the Permit Area.

Summary of Potential Impacts to protected species and water quality

The potential biological and ecological impacts associated with much larger hydrocarbon spills are presented in risk assessments for a loss of well integrity and hydrocarbon spills from vessel collision; further detail on impacts specific to a spill of marine diesel from a bunkering loss are provided below.

The biological consequences of such a small volume spill on identified open water sensitive receptors relate to the

potential for minor impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill affected area and no impacts to commercial fisheries are expected. Refer to the risk assessment for hydrocarbon spill from vessel collision for the detailed potential impacts; however, the extent of the ZoC associated with a marine diesel spill from loss during bunkering will be much reduced in terms of spatial and temporal scales, and hence, potential impacts from bunkering are considered very minor.
Summary of Controls
• Marine Order 91 (Marine pollution prevention – oil) 2006, requires SOPEP/ SMPEP (as appropriate to vessel class); • The Woodside Engineering Standard – Rig Equipment details requirements for the management of bunkering equipment to prevent bunkering spills; • The contractor bunkering procedures specify control measures to be implemented during bunkering / refuelling operations, to prevent spills from occurring; and • Mitigation: Oil spill response.

Unplanned Discharges: Drilling Fluids

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Accidental discharge of drilling fluids (WBM/base oil) to marine environment due to failure of slip joint packers, bulk transfer hose / fitting, emergency disconnect system or from routine MODU operations.		X	X		X	X		F	1	L
Description of Source of Risk										

Transfers

A support vessel will undertake bulk transfer of mud or base oil to the MODU, if and when required. Failure of a transfer hose or fittings during a transfer or backload, as a result of an integrity or fatigue issue, could result in a spill of mud or base oil to either the bunded deck or into the marine environment.

Similar to a spill event during refuelling, the most likely spill volume of mud is likely to be less than 0.2 m^3 based on the volume of the transfer hose and the immediate shutoff of the pumps by personnel involved in the bulk transfer process. However, the worst-case credible spill scenario could result in up to 8 m^3 of mud being discharged. This scenario represents a complete failure of the bulk transfer hose combined with a failure to follow procedures requiring transfer activities to be monitored, coupled with a failure to immediately shut off pumps (e.g. mud pumped through a failed transfer hose for a period of approximately five minutes).

Slip Joint Packer Failure

The slip joint packer enables compensation for the dynamic movement of the MODU (heave) in relation to the static location of the BOP. A partial or total failure of the slip joint packer could result in a loss of mud to the marine environment. The likely causes of this failure include a loss of pressure in the pneumatic (primary) system combined with loss of pressure in the back up (hydraulic) system.

Catastrophic sequential failure of both slip joint packers (pneumatic and hydraulic) would trigger the alarm and result in a loss of the volume of fluid above the slip joint (conservatively 1.5 m^3) plus the volume of fluid lost in the one minute (maximum) taken to shut down the pumps. At a flow rate of 1000 gallons per minute this volume would equate to an additional 3.8 m^3. In total, it is expected that this catastrophic failure would result in a loss of 5.2 m^3.

Failure of either of the slip joint packers at a rate not large enough to trigger the alarms could result in an undetected loss of 20 bbl (3 m^3) maximum assuming a loss rate of 10 bbl/hr and that MODU personnel would likely walk past the moon pool at least every two hours.

Activation of the EDS

The emergency disconnect sequence (EDS) is an emergency system that provides a rapid means of shutting in the well (i.e. BOP closed) and disconnecting the MODU from the BOP. There are two main scenarios where the EDS could be activated: (1) automatic activation of the EDS due to a loss of MODU station keeping that results from a “DP drive-off” or loss of power to the DP system or loss of multiple moorings; and (2) manual activation of the EDS due an identified threat to the safety of the MODU including potential collision by a third-party vessel or a loss of well control.

The activation of the EDS can result in the release of the entire volume of the marine riser to the marine environment. When drilling, this could result in a subsurface release of a combination of mud and cuttings at the seabed. The volume of material released depends on the water depth and hence, the length of the riser (the entire riser volume would be lost).

Base Oil

For the purposes of this risk assessment an example base oil (Saraline 185V) has been used. Saraline 185V is a mixture of volatile to low volatility hydrocarbons. Predicted weathering of base oil, based on typical conditions in the region, indicates that approximately 50% by mass is predicted to evaporate over the first day or two. At this time the majority of the remainder could be entrained into the water column, in calm conditions entrained hydrocarbons are likely to resurface with up to 100% will be able to evaporate over time.

Table 11-10: Characteristics of the non-water based mud base oil

Oil Type	Initial Density (kg/m³)	Viscosity (cP @ 20˚C)	Volatiles (%)<180	Semi volatiles (%)180-265	Low Volatility (%) 265-380	Residual (%) >380	Aromatic (%) Of whole oil < 380 °C BP
			Non-Persistent		Persistent		
Base oil (Saraline 185 v)	0.7760	2.0 @ 40ºC	8.5	41.1	50.4	0	0

Impact Assessment

Potential Impacts to water quality, other habitats and communities and protected species

Base oil has a high volatile to semi-volatile fraction. If released to the marine environment at surface, this generally evaporates within the first 48 hours, with the remaining fraction being on the sea surface and weathering at a slower rate. As a result of this volatility, combined with the worst-case credible spill scenario volumes (8 m^3), and based on Woodside's experience of modelling base oil, it is considered there would be an extremely small footprint area associated with any release. Therefore, any surface oil would be confined to open waters with a minor surface slick that would not reach any sensitive receptors. Therefore impacts on water quality would be minor and temporary in nature. The safety data sheet (SDS) for Saraline 185V indicates that it is readily biodegradable, non-toxic in the water column and has low sediment toxicity (Shell, 2014).Marine fauna may be affected if they come in direct contact with a release (i.e. by traversing the immediate spill area), but due to the small footprint of such a spill, it is anticipated that any impacts would be negligible and temporary in nature.

WBM is made up of a number of components including a variety of chemicals, incorporated into the selected drilling fluid system to meet specific technical requirements. If released to the marine environment at surface there would be an extremely small impact footprint area associated with a release. Any release would be confined to the open waters of the Petroleum Activity Program Operational Area that would not reach any sensitive receptors. Components of the WBM would settle out in the water column and be subject to dilution. Given the low toxicity of WBM and its planned discharge during drilling, any impacts on water quality would be minor and temporary in nature.

The ZoC associated with the release of WBM from the activation of the EDS would be small, and limited to deeper water seabed surrounding the well site (the release point). The environmental consequence of such a release would include a highly localised area at the discharge location. It is likely that any impacts to water and sediment quality and low-sensitivity deeper water benthos would be short term, localised and a full recovery expected.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that accidental discharge of base oil or water based mud will not result in a potential impact to protected species and water quality greater F with no significant impact on environmental receptors predicted. It is considered that the release of WBM cuttings from an unplanned discharge will not result in a potential impact greater than negligible and/or temporary contamination above background levels, water quality standards, or known effect concentrations.

Summary of Controls

- Woodside Engineering Standard for Rig Equipment specifies requirements for deck drainage and management of oily water for MODU;
- Implement Woodside's Chemical Selection and Assessment Environment Guideline for selection of drilling, completions, cementing and sub-sea control fluids and additives;
- Woodside's Engineering Standards – Rig Equipment requires the marine riser's telescopic joint to be:
  - Comprised of a minimum of two packers (one hydraulic and one pneumatic); and
  - Pressure tested in accordance with manufacturers recommendations;
- Mud transfers onto, around and off the MODU shall be managed using contractor procedures.

Unplanned Discharges: Venting of Gas (Well Kick)

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Unplanned venting of gas during drilling (i.e. well kick).				X				F	2	L

Description of Source of Risk
During drilling of the well, a kick may occur in the reservoir. A kick is an undesirable influx of formation fluid into the wellbore. The resultant effect would be a release of a small volume of greenhouse gases via the degasser to the atmosphere during well control operations.

Impact Assessment

Potential Impacts to air quality

Localised and temporary reduction in air quality as the gas vents to the atmosphere, and localised and temporary contribution to greenhouse gas emissions.

There is potential for human health effects for workers in the immediate vicinity of atmospheric emissions. However, the closest sensitive residential receptor is the town of Dampier, approximately 260 km south-east of the Permit Area; therefore, any risks associated with off-site human health effects are negligible beyond the immediate zone of release and dispersion.

Given the short duration and isolated location of the Petroleum Activities Program (which will lead to the rapid dispersion of the low volumes of atmospheric emissions) the potential impacts are expected to be minor.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that the release of a small volume of greenhouse gases via the degasser will not result in a potential impact greater than a localised and temporary impact to air quality with no lasting effect (i.e. Environment Impact - F).

Summary of Controls

- Accepted Well Operations Management Plan (WOMP) and application to drill;
- Regulatory scrutiny and acceptance of the Well Operations Management Plan (WOMP), which describes the well design and barriers to be used to prevent a loss of well control;
- Woodside Well Blowout Contingency Planning Procedure details specifications for well design to assess the feasibility of performing a well kill operation;
- Woodside Engineering Manual – Well Control Manual specifies the process to be undertaken to calculate, update and monitor kick tolerance for use in well design and while drilling; and
- Contractor Well Control Bridging Document to link to Woodside Engineering Manual – Well Control Manual.

Unplanned Discharges: Deck, Subsea Spills from ROV and spills from DST

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Accidental discharge to the ocean of other hydrocarbons / chemicals from MODU or support vessel deck activities and equipment (e.g. cranes) including helicopter refuelling and subsea ROV hydraulic leaks.			X		X	X		E	1	L
Accidental discharge to the ocean of hydrocarbons during DST if the flare is extinguished			X		X	X		E	1	L

Description of Source of Risk

Deck spills can result from spills from stored hydrocarbons/chemicals or equipment. Support vessels, ISVs and the MODU typically store hydrocarbon/chemicals in various volumes (20 L, 205 L; up to approximately 4000–6000 L). Storage areas are typically set up with effective primary and secondary bunding to contain any deck spills. Releases from equipment are predominantly from the failure of hydraulic hoses, which can either be located within bunded areas or outside of bunded or deck areas (e.g. over water on cranes). Helicopter refuelling may also take place within the Permit Area, on the helipad of the MODU.

Minor leaks during wireline activities (a contingent activity) with a live well are described to include leaks such as:

- leaks from the lubricator, stuffing box and hose or fitting failure, which are expected to be less than 10 L (0.01 m^3);
- loss of containment - fluids - surface holding tanks;
- back loading of raw slop fluids in an Intermediate Bulk Container/s (IBC);
- stuffing box leak / under pressure;
- draining of lubricator contents;
- excess grease / lubricant leaking from the grease injection head. Wind Blown lubricant dripping from Cable / on deck; and
- lubricant used to lubricate hole.

Woodside's operational experience demonstrates that spills are most likely to originate from hydraulic hoses and have been less than 100 L, with an average volume < 10 L.

Subsea spills can result from a loss of containment of fluids from subsea equipment including the BOP or ROVs. A review of these spills to the marine environment in the past 12 months showed subsea spills did not exceed approximately 26 litres in Woodside's Drilling function.

The ROV hydraulic fluid is supplied through hoses containing approximately 20 L of fluid. Hydraulic lines to the ROV arms and other tooling may become caught resulting in minor leaks to the marine environment. Small volume hydraulic leaks may occur from equipment operating via hydraulic controls subsea (subsea control fluid). These include the diamond wire cutter, bolt tensioning equipment, ROV tooling etc.

Hydrocarbons can be spilled to the marine environment during DST if the flare is extinguished.

Impact Assessment

Potential Impacts to water quality, other habitats and communities and protected species

Accidental spills of hydrocarbons or chemicals from the MODU, ISV, support vessels and drop out of hydrocarbons during DST will decrease the water quality in the immediate area of the spill; however, the impacts are expected to be temporary and very localised due to dispersion and dilution in the open ocean environment.

Given the offshore/ open water location, receptors such as marine fauna may be affected if they come in direct contact with a release (i.e. by traversing the immediate spill area). In the event that marine fauna come into contact with a release they could suffer fouling, ingestion, inhalation of toxic vapours, irritation of sensitive membranes in the eyes, mouth, digestive and respiratory tracts and organ or neurological damage. Cetaceans may exhibit avoidance behaviour patterns and given they are smooth skinned, hydrocarbons and other chemicals are not expected to adhere. Given the small area of the potential spill and the dilution and weathering of any spill the likelihood of ecological impacts to marine fauna (protected species), other communities and habitats is likely to be negligible to very minor. No impacts on socio-economic receptors are expected due to the low levels of fishing activity in the Permit Area, the small volumes of hydrocarbons/chemicals that could be accidentally spilt and the localised and temporary nature of the impacts.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that other hydrocarbon/chemical spills to the marine environment will not result in a potential impact greater than slight, short term local impacts on species, habitat (but not affecting ecosystems function), physical and biological attributes (i.e. Environment Impact – E).
Summary of Controls
• Marine Order 91 (Marine pollution prevention – oil) 2006, requires SOPEP/ SMPEP (as appropriate to vessel class); • Civil Aviation Safety Authority CAAP 92-4(0) 'Guidelines for the development and operation of off-shore helicopter landing sites, including vessels' include recommendations on fuel storage to prevent spills; • Environmental Performance Standards Procedure details expectations on chemical storage and handling to prevent spills; • Woodside's Engineering Standard – Rig Equipment details deck drainage system requirements to ensure that engineered barriers are in place to prevent loss of deck spills to the marine environment; and • Woodside's Engineering Standard – Rig Equipment includes requirements for onboard spill kits to be used to clean up deck spills.

Unplanned Discharges: Loss of Solid Hazardous and Non-hazardous Wastes/ Equipment

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Accidental loss of hazardous or non-hazardous wastes/ equipment to the marine environment (excludes sewage, grey water, putrescible waste and bilge water).			X		X	X		F	2	L

Description of Source of Risk

The project vessels will generate a variety of solid wastes including packaging and domestic wastes such as aluminium cans, bottles, paper and cardboard. Hence, there is the potential for solid wastes to be lost overboard to the marine environment. Woodside's Drilling function has not reported any significant loss of solid wastes to the marine environment during the past 12 months of operations. Equipment that has been recorded as being lost (primarily windblown or dropped overboard) have included the loss of a metal pole and hardhat These have occurred during back loading activities, periods of adverse weather and incorrect waste storage.

Impact Assessment

Potential Impacts to water quality, other habitats and communities, and protected species

The potential impacts of solid wastes accidentally discharged to the marine environment include direct pollution and contamination of the environment and secondary impacts relating to potential contact of marine fauna with wastes, resulting in entanglement or ingestion and leading to injury and death of individual animals. The temporary or permanent loss of waste materials into the marine environment is not likely to have a significant environmental impact, based on the location of the Permit Area, the types, size and frequency of wastes that could occur and species present.

Summary of Potential Impacts to environmental values(s)

Given the adopted controls, it is considered that the accidental discharge of solid waste described will result in localised impacts not significant to environmental receptors (i.e. Environment Impact – F).

Summary of Controls

- Marine Orders 95 – pollution prevention – Garbage (as appropriate to vessel class);
- The Drilling and Completions Waste Management Plan includes requirements for waste to ensure no waste is lost to the marine environment; and
- The MODU ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard.

Physical Presence: Vessel Collision with Marine Fauna

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Accidental collision between project vessels and threatened and migratory whale species.						X		E	1	L
Description of Source of Risk										
The MODU, ISV and support vessels operating in and around the Permit Area may present a potential hazard to cetaceans (e.g. pygmy blue whales) and other protected marine fauna such as whale sharks and marine reptiles. Vessel movements can result in collisions between the vessel (hull and propellers) and marine fauna, potentially resulting in superficial injury, serious injury that may affect life functions (e.g. movement and reproduction) and mortality. The factors that contribute to the frequency and severity of impacts due to collisions vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth) and the type of animal potentially present and their behaviours. Support vessels are typically stationary or moving at low speeds when supporting drilling operations; support vessels typically transit to and from the Permit Area between two and four trips per week (e.g. to port) when the MODU is present in the Permit Area										
Impact Assessment										
Potential Impacts to protected species										
The likelihood of vessel/whale collision being lethal is influenced by vessel speed; the greater the speed at impact, the greater the risk of mortality. Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from about 20% at 8.6 knots to 80% at 15 knots. Support vessels within the Permit Area are likely to be travelling less than 8 knots; therefore, the chance of a vessel collision with protected species resulting in lethal outcome is reduced. No known key aggregation areas (resting, breeding or feeding) are located within or immediately adjacent to the Permit Area; however, activities are located in the pygmy blue whale migration route BIA. The timing of the activity could occur at any time throughout the year (all seasons), therefore it is possible that activity will overlap with the pygmy blue whale migration season which occurs between April to August (north bound migration) and October to January (south bound migration). This could result in pygmy blue whales transiting the Permit Area during these months. According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk is less than 10% at a speed of 4 knots. Vessel-whale collisions at this speed are uncommon and, based on reported data contained in the US National Ocean and Atmospheric Administration database there only two known instances of collisions when the vessel was travelling at less than 6 knots, both of these were from whale watching vessels that were deliberately placed amongst whales. Whale sharks are at risk from vessel strikes when feeding at the surface or in shallow waters (where there is limited option to dive). Whale sharks may traverse offshore NWS waters including the Permit Areas during their migrations to and from Ningaloo Reef and whale sharks have been tracked moving across the Permit Area. However, it is expected that whale shark presence within the Permit Area would not comprise significant numbers given there is no main aggregation area within the vicinity of the Permit Area, and their presence would be transitory and of a short duration. Marine mammals and fish are at risk of mortality through being caught in thrusters during station keeping operations (dynamic positioning). The risk of marine life getting caught in operating thrusters is unlikely, given the low presence of individuals, combined with the avoidance behaviour commonly displayed during dynamic positioning operations. With consideration of the absence of potential nesting or foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals) and the water depth (at least ~1100 m), it is considered that the Permit Area is unlikely to represent important habitat for marine turtles, although individuals may infrequently transit the area. It is acknowledged that										

there are significant nesting sites along the mainland coast and islands of the region. It is unlikely, that vessel movement associated with the Petroleum Activities Program will have a significant impact on marine fauna populations given (1) the low presence of transiting individuals, (2) avoidance behaviour commonly displayed by whales and turtles and (3) low operating speed of the support vessels (generally less than 8 knots or stationary, unless operating in an emergency).
Summary of Potential Impacts to environmental values(s)
Given the adopted controls, it is considered that a collision, were it to occur, will not result in a potential impact greater than slight, short term impact on species (i.e. Environment Impact – E).
Summary of Controls
• EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, and Woodside's Marine Charterers Instructions.

Physical Presence: Disturbance to Seabed from Loss of Station Keeping

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Loss of station keeping of MODU leading to seabed disturbance.					X			E	1	L

Description of Source of Risk
In the event that a moored MODU is utilised, the rig will be secured on station by a number of morning lines, as dictated by the mooring analysis, which are held in place by anchors deployed to the seabed. High energy weather events such as cyclones, while the MODU is on station, can lead to excessive loads on the mooring lines resulting in failure (either anchor(s) dragging or mooring lines parting). A failure of mooring integrity may lead to the MODU losing station, which may lead to the mooring lines and anchors attached to the MODU being trailed across the seabed. For a moored MODU, personnel on-board the MODU are typically evacuated during cyclones. Woodside implements a risk-based assessment process to aid in decision making for cyclone evacuations, with the well suspended prior to MODU evacuation. Support vessels also demobilise from the Permit Area during the passage of a cyclone. While the MODU is temporarily abandoned, the position of the MODU is monitored remotely for any deviation. Support vessels and MODU personnel return to the Permit Area as soon as safe to do so following a cyclone evacuation. Operational experience indicates cyclone evacuations typically last for 7 days. Industry statistics from the North Sea show that a single mooring line failure for MODUs is the most common failure mechanism (33 x 10^{-4} per line per year), followed by a double mooring line failure (11 x 10^{-4} per line per year). Note that single and double mooring line failures do not typically result in the loss of station keeping. In the event of partial or complete mooring failures that are sufficient to result in a loss of station keeping, industry experience indicates that MODUs may drift considerable distances from their initial position. Partial mooring failures leading to a loss of station keeping resulted in smaller MODU displacements due to the remaining anchors dragging along the seabed when compared to complete mooring failures; complete mooring failures resulted in a freely drifting MODU.
Impact Assessment
Potential Impacts to Other Benthic Communities
Benthic habitats in the Permit Area are expected to largely consist of fine grained muddy sands and silts with an absence of hard substrate. In the unlikely event of a cyclone resulting in the MODU breaking its moorings, the anchors could cause physical damage to soft sediment and potentially limited hard bottom habitats (i.e. Exmouth Plateau KEF) and associated benthic communities (e.g. epifauna and infauna). This would result in localised short-term impacts to habitat and biological attributes. Given the low abundance, diversity and broad-scale distribution of the benthic habitat types within and adjacent to the Permit Area, the scale of impact will not be significant.
Summary of Potential Impacts to Environmental Values(s)
Given the adopted controls, seabed disturbance from a loss of station keeping will result in impacts to soft sediment benthic communities would result in only slight, short-term local impacts (i.e. Environment Impact - E).
Summary of Controls
• Woodside's Engineering Standard – Rig Equipment includes specifications and requirements for station keeping equipment (DP and mooring systems) to prevent failure of those systems; • MODU to be tracked when unmanned; and • Woodside's Engineering Standards – Rig Equipment and Mobile Offshore Drilling Unit Mooring Design require that a mooring analysis report be undertaken and implemented for anchor deployment to manage risks to anchor integrity associated with issues such as seabed type and expected weather conditions, including cyclonic conditions.

Physical Presence: Disturbance to Seabed from Dropped Objects

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Dropped objects resulting in seabed disturbance.					X			F	2	L

Description of Source of Risk
There is the potential for objects to be dropped overboard from the MODU and project vessels to the marine environment. Objects that have been dropped during previous offshore projects include small numbers of personnel protective gear (e.g. glasses, gloves, hard hats), small tools (e.g. spanners) hardware fixtures (e.g. riser hose clamp) and drill equipment (e.g. drill pipe). The spatial extent in which dropped objects can occur is restricted to the Permit Area.
Impact Assessment
Potential Impacts to Other Benthic Communities
In the unlikely event of loss of equipment or materials to the marine environment, potential environmental effects would be limited to localised physical impacts on benthic communities. As a result of recovery of any dropped objects this impact will be temporary in nature, however, if the object cannot be recovered due to health and safety, operational constraints and other factors (locating dropped objects at depth) then the impact will be long term. The temporary or permanent loss of dropped objects into the marine environment is not likely to have a significant environmental impact, as the benthic communities associated with the Permit Area are of low sensitivity and are broadly represented throughout the NWMR. One percent of the Exmouth Plateau KEF has been identified as overlapping the Permit Area. 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. Given only a small proportion of the KEF is overlapping the Permit Area, and the nature and scale of impacts and risks from dropped objects, seabed sensitivities associated with this KEF will not be significantly impacted. Further, considering the types, size and frequency of dropped objects that could occur, it is unlikely that a dropped object would have a significant impact on any benthic community.
Summary of Potential Impacts to environmental values(s)
Given the adopted controls and the predicted small footprint of a dropped object, it is considered that a dropped object will result in only localised impacts to a small area of the seabed and a small proportion of the benthic population; however not significant impact to environmental receptors, and with no lasting effect and (i.e. Environment Impact – F).
Summary of Controls
• The MODU ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard; • The MODU work procedures for lifts, bulk transfers and cargo loading; and • MODU inductions include control measures and training for crew in dropped object prevention.

Physical Presence: Accidental Introduction of Invasive Marine Species

Impacts and Risks Evaluation Summary										
Source of Risk	Environmental Value Potentially Impacted							Evaluation		
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/ Habitat	Species	Socio-Economic	Consequence	Likelihood	Current Risk Rating
Introduction of invasive marine species (IMS)					X	X	X	F	0	L

Description of Source of Risk

Vessels

During the Petroleum Activities Program, vessels will be transiting to and from the Operational Areas; potentially including traffic mobilising from beyond Australian waters. These project vessels may include the MODU, ISV and activity support vessels.

All vessels are subject to some level of marine fouling. Organisms attach to the vessel hull, particularly in areas where organisms can find a good attachment surfaces (e.g. seams, strainers and unpainted surfaces) or where turbulence is lowest (e.g. niches, sea chests etc.). Commercial vessels typically maintain anti-fouling coatings to reduce the build-up of fouling organisms. Organisms can also be drawn into ballast tanks during onboarding of ballast water as cargo is loaded or to balance vessels under load.

Submersible Equipment

The CAN will also be transported to the Operational Areas. As there is the potential for the CAN to be used on other project prior to use on this activity, there is the potential for IMS translocation. The CAN will be transported to the Operational Area on board the ISV (i.e. dry transport), this exposure to air, sun and high temperatures, will reduce any IMS translocation risk. Additionally, it is not expected that new IMS will settle on the CAN during use for the Petroleum Activities Program due to the deep waters in the Permit Area (see impact assessment below). This will minimise any risk of introducing IMS from the CAN.

During the Petroleum Activities Program, project vessels and the CAN have the potential to introduce IMS to the Permit Area through biofouling and IMS being carried on vessels as well as ballast water exchange (as described above). Cross contamination between vessels can also occur (e.g. IMS translocated between project vessels).

Impact Assessment

Potential Impacts to Ecosystems / Habitats, Species and Socio-economic Values

IMS, are a subset of Non-Indigenous Marine Species (NIMS), that have been introduced into a region beyond their natural biogeographic range resulting in impacts to social/cultural, human health, economic and/or environmental values. NIMS are species that have the ability to survive, reproduce and establish founder populations. However, not all NIMS introduced into an area will thrive or cause demonstrable impacts and the majority of NIMS around the world are relatively benign and few have spread widely beyond sheltered ports and harbours.

Potential IMS have historically been introduced and translocated around Australia by a variety of natural and human means including biofouling and ballast water. Potential IMS vary from one region to another depending on various environmental factors such as water temperature, salinity, nutrient levels and habitat type, which dictate their survival and invasive capabilities. IMS typically require hard substrate in the photic zone, therefore requiring shallow waters, to become established.

Once introduced, IMS may predate on local species (which had previously not been subject to this kind of predation and therefore not have evolved protective measures against the attack), they may outcompete indigenous species for food, space or light and can also interbreed with local species, creating hybrids such that the endemic species is lost. These changes to the local marine environment result in changes to the natural ecosystem.

IMS have also proven economically damaging to areas where they have been introduced and established. Such impacts include direct damage to assets (fouling of vessel hulls and infrastructure) and depletion of commercially harvested marine life (e.g. shellfish stocks). IMS have proven particularly difficult to eradicate from areas once established. If the introduction is detected early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life.

While project vessels (i.e. MODU, ISV, activity support vessels) and CAN have the potential to introduce IMS into the Permit Area, the deep offshore open waters of the Permit Area (1,100 to 1,600 m), away from shorelines and/or critical habitat, more than 12 nm from shore, mean the Permit Area is not conducive to the settlement and establishment of IMS. Given this, fisheries in the vicinity of the Permit Area are not expected to be vulnerable to credible introduction and establishment of IMS. Therefore, any impact will be temporary, only while the MODU or vessel is present, and have no lasting effect (e.g. duration of the activity).

Summary of Potential Impacts to environmental values(s)

In support of Woodside's assessment of the impacts and risks of IMS introduction associated with the petroleum activity program, Woodside conducted a risk and impact evaluation of the different aspects of a marine pest translocation. The results of this assessment are presented in the table below.

As a result of this assessment Woodside has presented the highest potential consequence as a D and likelihood as Remote (0), resulting in an overall Low risk following the implementation of identified controls.

IMS Introduction Location	Credibility of Introduction	Consequence of Introduction	Likelihood
Introduced to Operational Area and establishment on the seafloor or subsea structures (i.e. wellheads in the event they are left in situ).	**Not Credible** The deep offshore open waters of the Operational Area, away from shorelines and/or critical habitat, more than 12 nm from a shore and in waters 1,100 to 1,600 m deep are not conducive to the settlement and establishment of IMS.		
Introduced to Operational Area and establishment on a project vessel (i.e. MODU, ISV, activity support vessels) or CAN.	**Credible** There is potential for the transfer of marine pests between project vessels or the CAN within the Operational Area.	Reputation and Brand – D [7] If IMS were to establish on a project vessel (i.e. MODU, ISV, activity support vessels) this would potentially result in fouling of intakes (depending on the pest introduced), transfer of pests to other support vessels would likely result in the quarantine of the vessel or CAN until eradication could occur (through cleaning and treatment of infected areas), which would be costly to undertake. Such introduction would be expected to have minor impact to Woodside's reputation and brand, particularly with Woodside's contractors and would likely have a reputational impact on future proposals.	Remote (0) Interactions between project vessel will be limited during the petroleum activity program, with 500m safety exclusion zones being adhered to around the MODU, and interactions limited short periods of time alongside (i.e. during back loading, bunkering activities or CAN installation). There is also no direct contact (i.e. they are not tied up alongside) during these activities. Spread of marine pests via ballast water or spawning in these open ocean environments is also considered remote.
Transfer between project vessels and by extension from project vessels to other marine	**Not Credible** This risk is considered so remote that it is not credible for the purposes of the activity. The transfer of a marine pest between project vessels or the CAN was already		

[7] Note – the translocation of IMS from an "infected" MODU, ISV, activity support vessels or CAN to shallower environments via natural dispersion is not considered credible given the distances of the Operational Area from nearshore environments (i.e. 12nm/50 m water depth).

environments beyond the Operational Area (i.e. transfer of IMS from offshore MODU to an activity support vessel and then to another environment).	considered remote given the offshore open ocean environment (i.e. transfer pathway discussed above). For a marine pest to then establish into a mature spawning population on the new project vessel (which would have been through Woodside's IMS process) and then transfer to another environment is not considered credible (i.e. beyond the Woodside risk matrix). Project vessels will be located in an offshore, open ocean, deep environment, where IMS survival is implausible. Furthermore, this marine pest once transferred would need to survive on a new vessel with good vessel hygiene (i.e. has been through Woodside's risk assessment process), and survive the transport back from the Operational Area to shore. In the event it was to survive this trip, it would then need to establish a viable population in nearshore waters. Its' also noted that Woodside has been conducting marine vessel movements between offshore activities and ports (such as Dampier) for a long period of time, and no IMS has been detected in these ports.

Summary of Controls

- All vessels will undertake ballast water exchange or treat ballast water using an approved ballast water treatment system; and
- Woodside's IMS risk assessment process will be applied to project vessels which enter the Operational Area.

APPENDIX B: CONTROL MITIGATION MEASURES FOR POTENTIAL ENVIRONMENTAL IMPACTS ASSOCIATED WITH SPILL RESPONSE ACTIVITIES

Monitor and Evaluate

Response strategy risk and impact evaluation
Description of source of risk
Additional risks associated with the Monitor and Evaluate response not included within the scope of the EP include: *Seabed disturbance that may be associated with vessel anchoring* During the implementation of response strategies, 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 only when the impacted shoreline is inaccessible via road. *Presence of personnel* During the implementation of response strategies, it is possible that personnel may have minimal, localised impacts on habitats, wildlife and coastlines.
Previously assessed environmental risks
Field-based activities undertaken during the Monitor and Evaluate response strategy including monitoring, surveillance and reconnaissance involving vessel, aircraft operations, and shoreline surveys present risks to the environment. Several of these risks have been previously assessed within the scope of the EP (**Section 5**) including; • *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 –* • *Collision with marine fauna –* Refer to the EP for details about how these risks are being managed to an ALARP and acceptable level. **Note, any additional controls and environmental performance outcomes relating to these risks that are not presented in the EP but are specific to the Monitor and Evaluate response are presented below.*
Impacts and risks evaluation summary

	Environmental value potentially impacted						
	Soil and groundwater	Marine sediment quality	Water quality	Air quality	Ecosystems/ habitat	Species	Socio-economic
Standard control measures		X	X	X	X	X	X

Impact assessment
Potential impacts to marine sediments, water quality, air quality, protected species, socio-economic factors and protected areas.
Seabed disturbance that may be associated with vessel anchoring • Anchoring in the nearshore environment, such as the RPAs identified in Section 3, may affect nearshore coral reefs, seagrass beds and benthic communities in these areas. Impacts would be highly localised (restricted to the footprint of the vessel anchor) and temporary, with full recovery expected. **Presence of personnel during shoreline assessment operations resulting in disturbance to wildlife and habitats. The impacts associated with human presence on shorelines during shoreline surveys include:** • damage to vegetation/habitat to gain access to areas • damage or disturbance to wildlife and habitats during shoreline surveys • removal of surface layers of intertidal sediments (potential habitat depletion) • excessive removal of substrate, which can have erosion and instability effects.
Controls
The operational NEBA will consider the risks and benefits of conducting shoreline surveys. If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Vessel cleanliness would be commensurate with the receiving environment.

Source Control

Description of source of risk
If a worst-case loss of well control were to occur, source control would be the primary response strategy to reduce the volume of hydrocarbons released, potentially involving the following activities: • Vessel based deployment of the subsea first response toolkit (SFRT) to facilitate debris clearance by ROV • Vessel based deployment of a capping stack • Well intervention/relief well drilling

Impacts and risks evaluation summary

Response strategy	Environmental value potentially impacted						
	Soil and groundwater	Marine sediment quality	Water quality	Air quality	Ecosystems/ habitat	Species	Socio-economic
Source control		X	X	X	X	X	X

Previously assessed environmental risks
The risks and impacts of drilling a relief well are similar to those described in the EP for drilling activities. The remaining risks to the environment from vessel activities associated with implementation of the source control response fall within the scope of the EP (**Section 5)**, including: • *Atmospheric emissions –* • *Routine and non-routine discharges –* **Section 5.6.5** of the EP • *Physical presence, proximity to other vessels (shipping and fisheries) –* • *Routine acoustic emissions –* • *Lighting for night work/navigational safety –*

- *Collision with marine fauna* – **Section 5.7.9** of the EP
- *Disturbance to seabed* – **Section 5.6.2** of the EP

Refer to the EP for details on how these risks are being managed to an ALARP and acceptable level.

**Note, any additional controls and environmental performance outcomes relating to these risks that are not presented in the EP but are specific to the source control response are presented below.*

Impact assessment

Potential impacts to marine sediments, water quality, air quality, protected species, socio-economic and protected areas

The risks and impacts of drilling a relief well are similar to those described in the EP for drilling activities. The remaining risks to the environment from vessel activities associated with implementation of the source control response fall within the scope of the EP.

An environmental impact assessment, controls, environmental performance standards and measurement criteria for the sources of risk are within the scope of the EP (Section 5 of the EP). Implementing a source control response strategy will not result in a potential impact greater than localised, minor and temporary contamination above background levels and/or standards with localised, minor/negligible and temporary impacts to habitats or populations.

Containment and Recovery

Description of source of risk

CAR typically involves the deployment of boom and skimmers from suitable vessels, as well as the collection, transfer and disposal of oily water recovered during the response.

Additional risks associated with a CAR response not included within the scope of the EP include:

Waste generation and disposal leading to secondary contamination

It is possible for an unplanned release of recovered oily water to the marine environment – causing secondary contamination during transfer, decanting or transport activities that form part of a CAR response.

Response equipment obstructing wildlife

CAR equipment such as booms and skimmers have the potential to act as obstacles or trap wildlife.

Impacts and risks evaluation summary

Response strategy	**Environmental value potentially impacted**						
	Soil and groundwater	Marine sediment quality	Water quality	Air quality	Ecosystems/ habitat	Species	Socio-economic
Containment and Recovery		X	X	X	X	X	X

Previously assessed environmental risks

Potential risks to the environment from activities associated with the containment and recovery response that are covered within the scope of the EP (**Section 5)**, include:

- *Atmospheric emissions –*
- *Routine and non-routine discharges –*
- *Physical presence, proximity to other vessels (shipping and fisheries) –*
- *Routine acoustic emissions –*

- *Lighting for night work/navigational safety –*
- *Invasive marine species –*
- *Collision with marine fauna –*

See the EP for details on how these risks are being managed to an ALARP and acceptable level.

**Note, any additional controls and environmental performance outcomes relating to these risks that are not presented in the EP but are specific to the CAR response are presented below.*

Impact assessment

Potential impacts to marine sediments, water quality, air quality, protected species, socio-economic factors and protected areas

An environmental impact assessment, controls, environmental performance standards and measurement criteria for the sources of risk within the scope of the EP (as stated above) are detailed in Section 5 of the EP.

An evaluation of the impacts not within the scope of the EP are as follows:

Secondary contamination

Secondary contamination refers to hydrocarbons being re-released back to the environment during a response (potentially during CAR, oiled wildlife response and shoreline clean-up operations). The largest volume of oily water that could be spilt is conservatively considered to be 100 m^3; that is, the equivalent to the maximum volume stored by one CAR operation. Given the application of a conservative bulking factor of 10 when calculating the hydrocarbon content of the oily water mixture, the maximum volume of hydrocarbon that could be released is 10 m^3. The biological consequences of such a small-volume spill on identified open water sensitive receptors are likely to be similar to those associated with the unplanned release of hydrocarbons as a result of a bunkering scenario (Section 5.7.2 of the EP), and relate to the potential for minor impacts to megafauna, plankton and fish populations (surface and water column biota) within the spill affected area, with no impacts to commercial fisheries expected. Section 5.7.4 of the EP (potential impacts of unplanned hydrocarbon release to the marine environment from vessel collision) describes the detailed potential impacts from a hydrocarbon spill; however, the extent of the ZoC associated with a spill of recovered oily water from a CAR response will be much reduced in terms of spatial and temporal scales and thus the potential impacts are expected to be very minor.

Waste

Implementing the selected response strategies will result in the generation of the following waste streams that will require management and disposal:

- Liquids (recovered oil/water mixture) recovered from CAR operations
- Semi-solids/solids (oily solids) collected during CAR operations
- Debris (e.g. seaweed, sand, woods, plastics) collected during CAR 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. Woodside's waste management strategy to manage the potential volumes of waste generated by the selected response strategies is detailed in Section 6.9.

Response equipment obstructing wildlife

Typical booms used in CAR operations are designed to sit on the water surface, 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, many fauna, such as cetaceans, are likely to detect and avoid the spill area, and are not

expected to be present near the CAR operations.
Controls
Decanting would only occur when there is a net environmental benefit and when a net environmental benefit is demonstrated only in daylight hours and after a residence time of 30 minutes. The boom would also be monitored to ensure any trapped fauna are released as early as possible and containment and recovery operations would only take place in daylight hours. The transport and handling of all wastes in a response would be in accordance with the relevant licenses and regulations.

Shoreline Cleanup

Description of source of risk							
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. Given the predicted scale of shoreline impact, manual recovery is considered the most effective clean-up technique for the Petroleum Activities Program (**Annex A**). Additional risks associated with the shoreline clean-up response not included within the scope of the EP include: • Human presence (manual cleaning) • Sediment reworking • Vegetation cutting *Waste generation and disposal – see waste generation and disposal in Section 6.9 of this document.*							
Impacts and risks evaluation summary							
Response strategy	**Environmental value potentially impacted**						
	Soil and groundwater	Marine sediment quality	Water quality	Air quality	Ecosystems/ habitat	Species	Socio-economic
Shoreline Clean-up	X	X	X	X	X	X	X
Previously assessed environmental risks							
Potential risks to the environment from activities associated with the shoreline clean-up response that are covered within the scope of the EP (**Section 5**) include: • *Atmospheric emissions –* • *Routine acoustic emissions –* • *Lighting for night work/navigational safety –* See the EP for details on how these risks are being managed to an ALARP and acceptable level. **Note, any additional controls and environmental performance outcomes relating to these risks that are not presented in the EP but are specific to the shoreline clean-up are presented below.*							
Impact assessment							
Potential impacts to water quality, air quality, protected species, socio-economic factors and protected areas							
An environmental impact assessment, controls, environmental performance standards and measurement criteria for the sources of risk within the scope of the EP (as stated above) are detailed in the Section 5.							

An evaluation of the impacts not within the scope of the EP are as follows:

- Human presence (manual cleaning)
  - Compaction of sediments due to human presence, causing hydrocarbons to be buried or penetrate sediment further
  - Damage to vegetation/habitat to gain access to areas
  - Removal of surface layers of intertidal sediments (potential habitat depletion)
  - Excessive removal of substrate can have erosion and instability effects
- Sediment reworking
  - Remobilised oil could have impacts elsewhere (causing secondary contamination): further covered in **Section 5.6.6** of the EP
- Vegetation cutting
  - Cutting back too much vegetation could allow more oil to penetrate substrate
  - Removing too much vegetation or slow-growing vegetation can negatively affect wildlife (habitat loss)

Waste generation and disposal – see waste generation and disposal in Section 6.9 of this document.

Controls

Shoreline cleanup operations will only be conducted when there is a net environmental benefit associated with the response.

Zones and wash down areas would be set up in the event of a shoreline response to minimise the risk of secondary contamination.

Oiled Wildlife

Description of source of risk

An oiled wildlife response would involve reconnaissance from vessels, aircraft and shoreline surveys, as well as the capture, transport, rehabilitation and release of oiled wildlife.

Additional risks associated with the wildlife response, not included within the scope of the EP include:

- 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

Impacts and risks evaluation summary

Response strategy	Environmental value potentially impacted						
	Soil and groundwater	Marine sediment quality	Water quality	Air quality	Ecosystems/ habitat	Species	Socio-economic
Oiled wildlife	X	X	X	X	X	X	X

Previously assessed environmental risks

Potential risks to the environment from activities associated with the oiled wildlife response that are covered within the scope of the EP (**Section 5**) include:

- *Atmospheric emissions –*
- *Routine and non-routine discharges –*
- *Physical presence, proximity to other vessels (shipping and fisheries) –*
- *Routine acoustic emissions –*
- *Lighting for night work/navigational safety –*
- *Invasive marine species –*
- *Collision with marine fauna –*

See the EP for details on how these risks are being managed to an ALARP and acceptable level.

**Note, any additional controls and environmental performance outcomes relating to these risks that are not presented in the EP but are specific to the wildlife response are presented below.*

Impact assessment

Potential impacts to marine sediments, water quality, air quality, protected species, socio-economic factors and protected areas

An environmental impact assessment, controls, environmental performance standards and measurement criteria for the sources of risk within the scope of the EP (as stated above) are detailed in the **Section 5.**

An evaluation of the impacts not within the scope of the EP are as follows:

Impacts to wildlife

- Capturing wildlife
  - Inefficient capture techniques has potential to cause undue stress, exhaustion or injury to wildlife
  - Pre-emptive capture could cause undue impacts when oiling is not certain
- Transportation
  - Inefficient transport techniques have the potential to cause undue injury, stress and thermoregulation pressures to wildlife
- Stabilisation of wildlife
  - Inefficient stabilisation of wildlife techniques have the potential to cause injury to wildlife and thermoregulation stress, in addition to potential for euthanasia during the triage process.
- Cleaning and rinsing of oiled wildlife
  - Inefficient cleaning and rinsing techniques have the potential to cause injury and exhaustion of wildlife (e.g. removing the natural water-proofing on feathers).
- Rehabilitation (e.g. diet, cage size, housing density)
  - Inefficient rehabilitation techniques have the potential to cause injury and thermoregulation stress. Additionally, an inappropriate captive diet could result in further injury to wildlife.
- Release of treated wildlife
  - Potential for undue stress to wildlife if released in an unfamiliar site
  - Potential for rehabilitated wildlife to return to the oiled area of capture
  - Potential for stress when adjusting to the release site.

Shoreline surveys – risks associated with shoreline surveys are covered in Section 6.3 of this document

Waste generation and disposal – see waste generation and disposal in Section 6.9 of this document.

Controls
Oiled wildlife operations would be implemented via the direction of the Oiled Wildlife Advisor from the DBCA as per the OWRP. Shoreline access will be considered in the operational NEBA to ensure the environmental benefit outweighs the impact of conducting a response. Vehicular access would be restricted on dunes, turtle nesting beaches and in mangroves.

Scientific Monitoring

Description of Source of Risk

Field-based activities undertaken during SMP implementation include vessel operations in the nearshore and offshore environments, in addition to coastal monitoring and data collection at intertidal and subtidal habitats, resulting in potential impacts to the receiving environment.

Additional risks associated with Scientific Monitoring implementation not included within the scope of the EP include:

Seabed disturbance that may be associated with Vessel anchoring

During the implementation of response strategies, 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 to SMP teams.

Impacts and Risks Evaluation Summary

Response Strategy	Environmental Value Potentially Impacted						
	Soil & Groundwater	Marine Sediment Quality	Water Quality	Air Quality	Ecosystems/Habitat	Species	Socio-Economic
Scientific Monitoring	X	X	X	X	X	X	X

Previously Assessed Environmental Risks

Potential risks to the environment from activities associated with the SMP field activities that are covered within the scope of the EP (Section 5), include:

- 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 –
- Collision with marine fauna-

Refer to the EP for details regarding how these risks are being managed to an ALARP and acceptable level.

Note, any additional controls and environmental performance outcomes relating to these risks that are not presented in the EP but are specific to the SMP are presented below.

Impact Assessment

Potential Impacts to marine sediments, water quality, air quality, protected species, socio-economic and protected areas

Seabed disturbance that may be associated with Vessel anchoring

Anchoring in the nearshore environment of sensitive receptor locations will have 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.

APPENDIX C: SUMMARY OF STAKEHOLDER FEEDBACK AND WOODSIDE'S ASSESSMENTS AND REPONSES

Relevant Stakeholder feedback for the Petroleum Activities Program

Organisation	Method	Feedback	Woodside assessment	Woodside's Response
Department of Industry Innovation and Science	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Department of Mines, Industry Regulation and Safety *(formerly Department of Mines and Petroleum (WA DMP)*	Email with fact sheet	**Date:** 13 July 2017 **Feedback summary:** The Department thanked Woodside for keeping it informed on Woodside's activities in Commonwealth waters. The Department advised that the information package on the proposed drilling activities in WA-404-P has been reviewed and acknowledged that these activities will be regulated by NOPSEMA under the OPGGS(E)R. The Department advised that no further information is required at this stage and requested Woodside continues to keep the Department informed.	The stakeholder raised no claims or objections.	**Response/Action:** No further action required.

		Date: 16 August 2017 **Feedback summary:** ` The Department thanked Woodside for providing them with the Noblige-1 well P&A activity update. The Department advised the fact sheet has been reviewed and no further information is required.		
Australian Maritime Safety Authority (AMSA) – Maritime Safety	Email with fact sheet	**Date:** 5 July 2017 **Feedback summary:** The Authority thanked Woodside for sending AMSA information on Woodside's proposed Ferrand well exploration and appraisal drilling activities. The Authority provided a vessel traffic plot showing the Ferrand well site within permit block WA-404-P with 3 months of AIS traffic data, and advised on vessel traffic to be expected in the area. The Authority advised that commercial shipping will be encountered during the life of the drilling activities. Therefore, the MODU and its support	Woodside acknowledges the Authority's advice regarding expected traffic in the area and its communication requirements.	**Response/Action:** Woodside to observe communication requirements for vessel interactions. Requested advice to be supplied to AMSA's JRCC and AHS within outlined timeframes. Woodside acknowledges commercial shipping traffic and has included it in the risk section of the EP.

		vessels will need to be active and maintain exceptional communications with any nearby commercial shipping. The Authority advised on the communication requirements between the MODU and support vessels with nearby commercial shipping. The Authority requested that the MODU notify AMSA's Joint Rescue Coordination Centre (JRCC) 24-48 hours before operations commence and provided the details required. The Authority advised that the Australian Hydrographic Service must be contacted no less than four working weeks before operations commence for the promulgation of related notices to mariners. **Date:** 17 August 2017 **Feedback summary:** The Authority thanked Woodside for the notification of the addition of plug and abandonment activities under the proposed WA-404-P Environment Plan.		

		The Authority provided an updated historical AIS traffic plot of the area and reiterated that commercial shipping can be encountered anywhere within WA-404-P. The Authority advised historical shipping concentrations for this area are low, with the majority of traffic transiting through the designated fairways to the east and west. The Authority noted the change to the draft EP and stated that previous advice provided by AMSA on 5 July 2017 remains extant.		
Australian Hydrographic Service (AHS)	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** AHS confirmed receipt of Woodside's advice via email. **Date:** 17 August 2017 **Feedback summary:** AHS confirmed receipt of Woodside's advice on the addition of the Noblige-1 P&A activity via email.	The stakeholder raised no claims or objections.	**Response/Action:** No further action required.
Pearl Producers Association	Email with fact sheet and state fisheries map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.

		Feedback summary: No response at the time of submission.		
Department of Primary Industries and Regional Development (DPIRD) (Western Australia) *(formerly Department of Fisheries)*	Email with fact sheet and state fisheries map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 15 Sept 2017 **Feedback summary** The Department via email recommends Woodside engages with WAFIC, Recfishwest, fishers and charter boat operators in the area. The Department advised that its advice remains valid should the proposed activity commence within six months, otherwise advice may be updated. The Department requests to be reconsulted in a reasonable period of time should the activities occur outside of this timeframe. The Department recommended resources for Woodside to demonstrate it has taken reasonable measures to reduce its chances of carrying out offences under the *Fish Resources Management Act 1994* and associated	Woodside acknowledged the Department's advice via email on 20 September 2017. Woodside confirmed the stakeholders that it had engaged and will continue to engage with about the proposed activity. Woodside acknowledged the timeframe that the Department's advice remains valid. Woodside ensures compliance with biosecurity requirements through its implementation of its own Invasive Marine Species Management Plan, which is supported at a Commonwealth level. This process demonstrates compliance with the *Fish Resources Management Act 1994*. Woodside encourages its contractors to use the Department's Vessel Check tool to proactively manage Invasive Marine Species risk when not on contract to the company.	**Response/Action:** No further action required.

		regulations. The Department requested that suspected or confirmed marine pest or disease is report within 24 hours. The Department requested contact by phone and email in the event of a hydrocarbon spill within 24 hours of Woodside reporting the incident to the relevant Authority. The Department requested that specific strategies are developed in the EP to mitigate impacts on fish spawning.	Woodside advised that suspected or confirmed presence of marine pest or disease will be reported to the Department within 24 hours. In the unlikely event of an oil spill or discharge into the environment, Woodside will notify relevant agencies and organisations as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. Woodside selects oil spill response strategies based on Net Environmental Benefit Analysis (NEBA). The NEBA process takes into account potential benefits/impacts of response strategies to all environmental sensitivities. Woodside confirms that the NEBA process includes analysis of potential benefits/impacts of spawning grounds and nursery areas.	
Commonwealth Fisheries • North West Slope Trawl Fishery • Western Skipjack	Email with fact sheet and commonwealth fisheries map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.

Fishery • Western Tuna and Billfish Fishery • Southern Bluefin Tuna Fishery • Western Deepwater Trawl Fishery		**Feedback summary:** No response at the time of submission.		
Western Australian Fisheries • Mackerel Fishery • West Coast Deep Sea Crustacean • Pearl Oyster	Mail with fact sheet and state fisheries map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Australian Maritime Safety Authority (AMSA) – Oil Spill Preparedness, Marine Pollution	Email with fact sheet First strike plan	**Date:** Fact sheet provided to stakeholder on 27 June 2017 and Oil Pollution First Strike Plan provided on 1 September 2017. **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Department of Transport	Email with fact sheet and shipping map. First strike plan	**Date:** Fact sheet provided to stakeholder on 27 June 2017 and Oil Pollution First Strike Plan provided on 1 September 2017. **Feedback summary:** No response at the time of submission. **Date:** 28 September 2017	Woodside acknowledged the Department's advice via email on 28 September 2017. Woodside confirmed the following: - The controlled reference number is provided for the attached First Strike Response Plan	**Response/Action:** No further action required.

		Feedback summary: The following comments have been generated from the information provided: 1. Ensure that documents submitted to the Department of Transport (DoT) have appropriate document control numbers so that it is easier for us to track which document we are looking at. 2. There are a number of references to facilities in the WA 404-P Exploration and Appraisal Well Drilling Project – Oil Pollution First Strike Plan, Rev B. Clarify if facilities are part of this First Strike Plan. 3. Provide some detail around the zone of potential impact and clarify if any oil spill trajectory models have been run for the worst case spill scenario. For example, where is the zone, what could potentially be impacted, are shoreline impacts expected in the event of a spill, what time would it take for a spill to reach shorelines? 4. Have tactical response plans been developed for the zone of potential impact? If so, please send copies through to DoT.	- The facility refers to the drill rig/ vessel for this activity - Woodside have modelled the Worst Case Credible Scenario for this activity (a loss of well control for 105 days) and a summary of the modelling results has been provided - Tactical response plans have been developed for the Response Priority Protection Areas. However, given the time to potential contact are not provided in the First Strike Plan. Copies of these Tactical Response Plans have been previously provided to DoT with the exception of the Jurabi to Lighthouse TRP which is provided with this email. - The reference to DoT equipment has been deleted, given that Woodside would prioritise the use of Woodside owned and AMOSC equipment in a first strike response.	

		Page 2 of 2 5. Section 1 of the First Strike Plan details that in the event that a spill occurs the Marine Duty Manager will notify WA DoT and request use of the equipment stored at Harold E Holt. Please confirm that Woodside have their own equipment to use and are not relying on DoT equipment as the primary response option. 6. Section 1 also states that ‘if spill enters State waters DoT representative becomes a Deputy Incident Controller acting on behalf of the State Marine Pollution Coordinator (SMPC) and will coordinate sign off by the SMPC on actions in the Incident Action Plan that relates to activities in State waters.’ Provide some context around the relevance of this statement. 7. Have regional operations centres been identified for this activity? And if so, where are they likely to be established? **Date:** 10 October 2017 **Feedback summary**: DoT responded with no further comments on the information received from Woodside.	- Updates related to the Incident controller have been updated in the First Strike Plan - A Forward Operating Base would be established at Exmouth and/or Dampier. The most likely location in Dampier is KBSB and in Exmouth would be Harold E Holt.	

Western Australian Fishing Industry Council (WAFIC)	Email and face-to-face meeting with fact sheet and state fisheries map	**Date:** 18 July 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Department of Defence	Email with fact sheet and defence map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Australian Fishing Management Authority (AFMA)	Email with fact sheet and commonwealth fisheries map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Commonwealth Fisheries Association	Email with fact sheet and commonwealth fisheries map	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.

		response at the time of submission.		
Karratha Community Liaison Group (CLG)	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Chevron as neighbouring title holders	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Dampier Port Authority	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.

Interested Stakeholder feedback for the Petroleum Activities Program

Organisation	Method	Feedback	Woodside assessment	Woodside's Response
National Offshore Petroleum Titles Administrator (NOPTA)	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Department of Biodiversity, Conservation and Attractions (DBCA) *(formerly Department of Parks and Wildlife)*	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Australian Customs Service – Border Protection Command	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Recfishwest	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.

		Feedback summary: No response at the time of submission.		
WWF	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Australian Conservation Foundation	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
Wilderness Society	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
International Fund for Animal Welfare (IFAW)	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of	Woodside will accept and assess feedback from stakeholder post EP	**Response/Action:** No further action required.

		submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	submission to NOPSEMA.	
Australian Petroleum Production & Exploration Association (APPEA)	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.
AMOSC - Oil spill preparedness Australian waters	Email with fact sheet	**Date:** 27 June 2017 **Feedback summary:** No response at the time of submission. **Date:** 16 August 2017 **Feedback summary:** No response at the time of submission.	Woodside will accept and assess feedback from stakeholder post EP submission to NOPSEMA.	**Response/Action:** No further action required.