PTTEP Australasia

# TECHNICAL DOCUMENT

Approval Status: **APPROVED**

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|---|---|---|---|
| Title: | **Cash Maple Drilling Program Environment Plan Summary** | | |
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|---|---|---|---|
| 0 | 28/11/2013 | Summary of Environment Plan | GLEN NICHOLSON |

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# 1 INTRODUCTION

PTTEP Australasia (Ashmore Cartier) Pty Ltd (PTTEP AA), a part of the PTTEP Australasia Group, proposes to undertake a drilling program to drill and evaluate three wells, Cash-3, Maple-3 in the title area AC/RL7 and Maple East-1 in the title area AC/P54, in order to appraise the fields and provide a better definition of the hydrocarbon reserves.

The Cash Maple Drilling Program Environment Plan (EP) (CORP-HSE-D41-831645) was accepted by NOPSEMA on 22nd November 2013.

This EP summary document has been prepared to comply with the requirements of Regulation 11(7) and (8) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

# 2 LOCATION OF ACTIVITY

The drilling program will take place in Commonwealth waters within the title areas AC/RL7 and AC/P54, approximately 690 km west of Darwin, 620 km north-east of Broome and 200 km south-east of the Indonesian coastline (refer to Figure 1). The activity is located within the Territory of Ashmore/Cartier in water depths of approximately 130m at the proposed well sites with coordinates listed in Table 1.

**Table 1 Proposed Well Locations**

| Well | Cash-3 | Maple-3 | Maple East-1 |
|---|---|---|---|
| **Latitude** | 11º 56´ 30.2" | 12º 00´ 21.4" | 11º 59´ 38.6" |
| **Longitude** | 124º 36´ 41.6" | 124º 34´ 31.7" | 124º 40´ 27.0" |

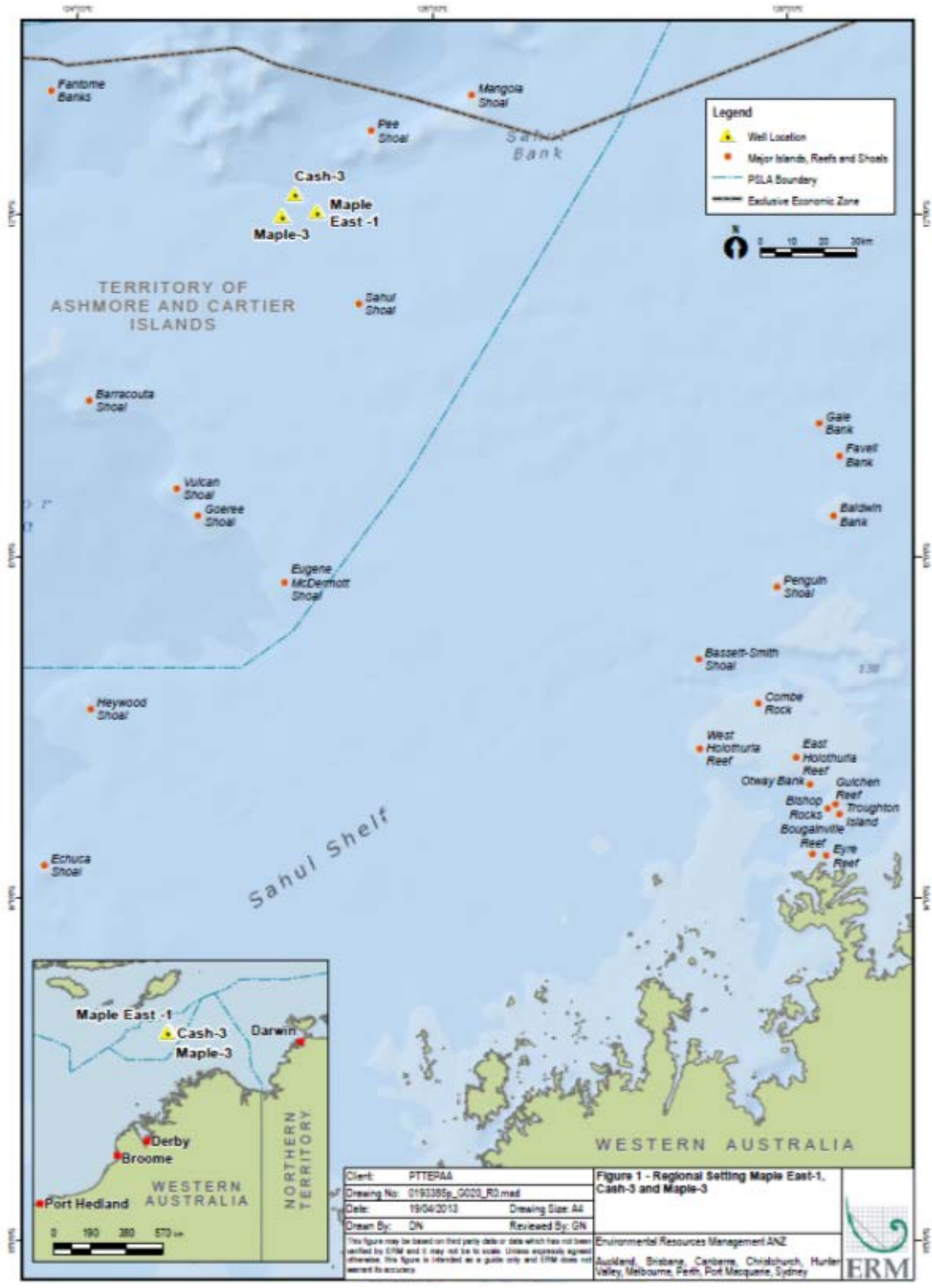


**Figure 1 – Cash-3, Maple-3 and Maple East-1 Location Map**

# 3 DESCRIPTION OF ACTIVITY

The activity will involve drilling three vertical wells, Cash-3, Maple-3 and Maple East-1 to a total depth of approximately 4200 m below depth. Drilling is scheduled to commence in Q1 2014 and last for approximately 50 days per well using the same MODU and associated support vessels. Timings and durations are indicative and are contingent on MODU availability, operational efficiency and weather conditions.

To date, eight wells have been drilled by various operators in and around the title areas AC/RL7 and AC/P54, resulting in the discovery of the Cash and Maple gas fields. The activity covered will involve the drilling of three wells to further test the reservoir deliverability in the Cash-Maple structure. Drilling is expected to encounter gas- condensate but no oil.

A summary of the drilling activity is provided in Table 2 below.

**Table 2 - Summary of Drilling Activity**

| | |
|---|---|
| **MODU** | The drilling contractor selected to execute the drilling program is Stena Drilling (Australia) Pty Ltd with the well to be drilled using the semi-submersible Stena Clyde Mobile Offshore Drilling Unit (MODU). The Stena Clyde is a self-propelled, semi-submersible, twin pontoon, column stabilised drilling unit. |
| **Anchoring** | The MODU will be held in position using a mooring spread consisting of eight mooring lines with an anchor fitted to the end of each line and set into the seabed. The mooring line will be a chain and anchors will be deployed by a support vessel keeping the MODU on well centre by maintaining tension on the anchor chains. |
| **Drilling Method** | Three vertical wells, Cash-3, Maple-3 and Maple East-1 are scheduled to be drilled to a total depth of 4200 m below sea surface over 50 days for each well, subject to weather and operational efficiency. The first and the largest section of each well will be established from the seabed. As drilling progresses, the wells are drilled deeper into the formations and the cased sections become progressively smaller in diameter. The first well section will be drilled with the largest drilling bit diameter of 36" with the final wellbore section being 8.5" in diameter. The casing design is typical of a Browse Basin well, where 762mm (30”) conductor is set followed by 508mm (20”), 340mm (13 3/8”) and 244mm (9 5/8”) casing strings set before setting a 178mm (7”) test liner in a success case.<br>The majority of the well sections shall be drilled using Water Based Mud, however the 8.5’’ sections for each of the three wells may require to be drilled using Synthetic Based Mud. No Oil Based Muds will be used during the activity.<br>Cement is used to secure the steel casing in the well bore and cementing chemicals are used to modify the technical properties of the cement slurry. During cementing operations, the majority of these chemicals are left downhole but a small quantity of cement may be discharged onto the seabed around the top of the casing. |
| **Well Evaluation** | **Formation Evaluation**<br>Formation evaluation is the interpretation of a combination of measurements taken inside a wellbore to detect and quantify oil and gas reserves in the rock adjacent to the well. Mud-logging will be undertaken during drilling to evaluate the drilled formations. This will involve collection and processing of cuttings samples, analysis of mud gas, monitoring and recording of all drilling parameters, pit levels and pressure detection. A wireline log is a continuous measurement of formation properties with electrically powered instruments to enable decisions to be made about drilling operations. Wireline logging may be required if the formation differs significant to that expected.<br>**Vertical Seismic Profiling**<br>At present, it is not anticipated that a Vertical Seismic Profile (VSP) will be undertaken as part of the activity. However, should logging data indicate significantly different formation is encountered than expected, VSP may be |

| | |
|---|---|
| | required.<br>**Well Testing**<br>Depending on the results from well evaluation, well testing may be undertaken on each well. A temporary well test production package will be used whilst wells are flowing to gather information on the reservoir. Hydrocarbons flowed during the test will be flared on the MODU. Testing will be undertaken in accordance with the applicable Well Operations Management Plan (WOMP).<br>**Well Abandonment**<br>At the end of the drilling campaign, each well will be plugged and abandoned in accordance with the applicable Application to Undertake Well Activity and WOMP. A combination of verified barriers (i.e. mechanical plugs and cement plugs) will be used to isolate and abandon the well. The casings will be cut below the sea floor to ensure nothing remains above the seabed level. |
| **Support Operations** | The MODU is expected to have a complement of between 100 – 130 personnel and will be supported by up to three support vessels as well as regular helicopter flights from the mainland. At least one support vessel will be present at all times for safety purposes.<br>Support vessels will primarily be used to transport equipment and materials between the MODU and the port of Darwin. They will also be used to tow the MODU to the well locations.<br>Helicopter support is based at Mungalalu – Truscott air base to undertake personnel transfers between Mungalalu-Truscott and the MODU for crew changes; down-manning of the MODU for tropical cyclone response; and emergency response, including medivac, evacuation of the MODU, and search and rescue.<br>Helicopter transfers may occur five to six days of the week to allow planned/preventative maintenance on the other day(s). There will be approximately 5 to 7 helicopter flights to the MODU per week that will service regular crew change requirements and facilitate transfer of specialist personnel required to carry out short term duties. |

# 4 DESCRIPTION OF RECEIVING ENVIRONMENT

## 4.1 PHYSICAL AND BIOLOGICAL ENVIRONMENT

The wells are located on Australian continental shelf in the Timor Sea. In general, the continental shelf is a flat featureless submarine plain that dips gently northward toward the edge of the shelf, but scattered throughout the region are sea mounts, shoals and occasional islands that support a diverse flora and fauna. The Timor Trough, with water depths up to 9,000 m, marks the northern boundary of the continental shelf.

Regionally, the wells are located in the Timor Province Bioregion of the North West Marine Region and within the larger Northwest Marine Region (NWMR) Planning Area. The variety of geomorphic features in the Timor Province results in several distinct habitats and biological communities, many of which are in close proximity to each other. The reefs and islands of the bioregion are regarded as particular hotspots for biodiversity and support a range of important pelagic and benthic ecological communities. A high level of endemism has been identified in demersal fish communities of the continental slope in the Timor Province, with two distinct communities identified (upper slope and mid slope). Almost half of the reefs in the NWMR occur in the Timor Province Bioregion, including Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef which occur in excess of 130 km south west of the well locations.

The title areas fall in the continental shelf zone on the Sahul Shelf in approximately 130m of water. The Sahul Shelf is predominantly comprised of soft sediment with little topographic relief and subsequently little diversity in habitat. The extensive soft sediment habitat, in combination with little topographic relief, has very large expanses of monotonous benthos because there are limited different habitats or niches for animals to occupy.

A number of ecologically rich shoals are found within a 200 km radius of the title area, with Pee Shoal the closest at 30km distant. Studies of a number of these shoals by the Australian Institute of Marine Science and ERM (2012) confirmed that they contained diverse communities of flora and fauna dominated by photosynthetic organisms and there are pronounced differences in abundances of species between each shoals yet similarities in the species found (Heyward et al., 2010; Heyward et al, 2011).

PTTEP AA commissioned ERM to carry out a benthic habitat assessment at Cash Maple Oliver and Southern gas fields (ERM, 2012). The benthic habitat assessment revealed a flat, featureless, soft sediment habitat across the fields, with an abiotic cover predominately consisting of sand and small rubble fragments (ERM, 2012).

## 4.2 PROTECTED FAUNA

An EPBC Act Protected Matters Database search for endangered and vulnerable marine species was undertaken based on the location of the activity. The search identified a total of nine species listed as Threatened and Migratory and six species listed as Migratory that may occur, or are known to occur, within a 20 km radius of the well locations (Activity Area). The listed threatened and/or migratory species are in Table 3 below.

**Table 3 - EPBC Listed and or Migratory Species that May Occur in the Title Areas**

| Species Type | Scientific Name | Common Name | Status | Type of Presence |
|---|---|---|---|---|
| **Cetaceans** | *Balaenoptera musculus* | Blue whale | Endangered, Migratory | Species or species habitat may occur within area |
| | *Megaptera novaeangliae* | Humpback whale | Vulnerable, Migratory | Species or species habitat may occur within area |
| | *Balaenoptera bonaerensis* | Antarctic minke whale | Migratory | Species or species habitat may occur within area |
| | *Balaenoptera edeni* | Bryde's whale | Migratory | Species or species habitat may occur within area |
| | *Orcinus orca* | Killer whale, orca | Migratory | Species or species habitat may occur within area |
| | *Physeter macrocephalus* | Sperm whale | Migratory | Species or species habitat may occur within area |
| **Marine Reptiles** | *Caretta caretta* | Loggerhead turtle | Endangered, Migratory | Species or species habitat may occur within area |
| | *Chelonia mydas* | Green turtle | Vulnerable, Migratory | Species or species habitat may occur within area |
| | *Dermochelys coriacea* | Leatherback turtle | Endangered, Migratory | Species or species habitat may occur within area |
| | *Eretmochelys imbricata* | Hawksbill turtle | Vulnerable, Migratory | Species or species habitat may occur within area |
| | *Lepidochelys olivacea* | Olive ridley turtle | Endangered, Migratory | Species or species habitat may occur within area |
| | *Natator depressus* | Flatback turtle | Vulnerable, Migratory | Species or species habitat may occur within area |
| | *Aipysurus apraefrontalis* | Short-nosed Seasnake | Critically Endangered | Species or species habitat may occur within area |
| | *Aipysurus foliosquama* | Leaf-scaled Seasnake | Critically Endangered | Species or species habitat may occur within area |
| **Fish** | *Rhicodon typus* | Whale Shark | Vulnerable | Species or species habitat may occur within area |
| **Marine Birds** | *Calonectris leucomelas* | Streaked shearwater | Migratory | Species or species habitat may occur within area |

| Species Type | Scientific Name | Common Name | Status | Type of Presence |
|---|---|---|---|---|
| | *Puffinus leucomelas* | Streaked shearwater | Migratory | Species or species habitat may occur within area |
| | *Anous tenuirostris melanops* | Australian Lesser Noddy | Vulnerable | Species or species habitat may occur within area |

## Cetaceans

The EPBC Act Protected Matters database did not identify known foraging, feeding, breeding or aggregation areas for cetaceans within the Activity Area. However, transient marine species have the potential to traverse the Activity Area; therefore descriptions on the known distribution and occurrence of potential transient species are provided below.

Two species are listed as threatened under the EPBC Act and may occur in or around the Activity Area:

- Blue Whale (endangered/migratory).
- Humpback Whale (vulnerable/migratory).

### *Blue Whale (Endangered/Migratory)*

Blue whales (*Balaenoptera musculus*) have been documented from all around Australia, suggesting that the species has a broad distribution (DSEWPaC, 2013) and are widely distributed throughout the worlds' oceans. There are two subspecies in the Southern Hemisphere: the southern blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*Balaenoptera musculus brevicauda*) (DEWHA, 2008). In general, the southern blue whale is found south of 60° S and pygmy blue whales are found north of 55° S (DEWHA, 2008), it is therefore likely that any blue whales encountered in the title areas would be pygmy blue whales.

Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (DSEWPaC 2013). Sea noise loggers set at various locations along the coast of Western Australia have detected a seasonal presence indicating a pattern of annual northbound and southbound migration of pygmy blue whales past Exmouth and the Montebello Islands and locations to the north (McCauley and Jenner 2010). Pygmy Blue whales appear to migrate south from Indonesian waters passing Exmouth through November to late December each year. Observations suggest most Pygmy Blue whales pass along the shelf edge out to water depths of 1,000m but centred near the 500m depth contour. The northern migration passes Exmouth over an extended period ranging from April to August (McCauley and Jenner 2010).

The Perth Canyon is the only area so far identified off the Western Australia coast where pygmy blue whales aggregate with some predictability. The area represents a significant feeding ground for pygmy blue whales between January and April (McCauley and Jenner 2010). Blue whales are believed to calve in tropical waters in winter and births peak in May to June, however the exact breeding grounds of this species are unknown (Bannister *et al.* 1996).

The EPBC Act Protected Matters database indicates that the Activity Area is located outside of the recognised Blue whale migratory routes, known feeding breading or resting areas.

### *Humpback Whale (Vulnerable/Migratory)*

Humpback whales (*Megaptera novaeangliae*) have a wide distribution and have been recorded from the coastal areas off all Australian states except the Northern Territory (Bannister et al., 1996). Humpback whales migrate north and south along the eastern and western coasts of Australia from calving grounds in the tropical north to feeding grounds in the Southern Ocean (DSEWPaC, 2013). Peak northward migration off the north-western coast of Australia occurs from late July to early August and peak southward migration from late August to early September. From June to mid-September the inshore waters landward of the 100 m isobath between the Lacepede Islands and Camden Sound (300 400 km south-west) are used as a calving area by this species (Jenner et al., 2001).

The EPBC Act Protected Matters database indicates that the Activity Area is located outside of the recognised Humpback whale migratory routes which are usually within 30 kilometres of the coastline.

***Other Migratory Cetaceans***

In addition to the humpback whale and blue whale, four other migratory cetacean species have the potential to occur within the Activity Area:

- Antarctic minke whale;
- Bryde's whale;
- Killer whale; and
- Sperm whale.

Surveys conducted in response to the Montara incident recorded a total of 462 individual cetaceans. Four different species were positively identified: false killer whale, common bottlenose dolphin, pantropical spotted dolphin and long-snouted spinner dolphin (Watson *et al.* 2009). Twenty-four individuals could not be identified.

Due to the open oceanic conditions of Activity Area, there are no features such as feeding or breeding grounds that will cause cetaceans to concentrate. The Activity Area is not located near any known migration route (Jenner *et al.* 2001). There is potential for cetaceans to travel through the area however, most of these species tend to move individually or in small pods and do not aggregate.

## Dugongs

Dugongs (*Dugong dugon*) are protected under the *Wildlife Conservation Act 1950 WA* and are listed as migratory and protected species under the EPBC Act. Dugongs feed exclusively on seagrass and are found in shallow, protected waters in tropical and sub-tropical regions. The distribution of dugongs in Australia ranges from Shark Bay in WA extending around the Northern Territory coastline to Moreton Bay in Queensland (Marsh and Lefebvre 1994).

Dugongs are known to frequent Ashmore Reef, with estimates of between 10 to 60 individuals (Whiting and Guinea 2005), and are likely to extend to Cartier Island as critical seagrass habitat is available (Commonwealth of Australia 2002). A dugong has also been recorded 130 km east of Ashmore Reef, indicating that dugongs may also use other shallow shoals on the Sahul Banks (Whiting and Guinea 2005).

Although there is limited information on the presence of dugongs in deeper offshore waters, the absence of food suggests that this is unlikely.

## Turtles

The EPBC search recorded six species of marine turtle that may occur in the Activity Area (loggerhead, green, leatherback, hawksbill, olive ridley and flatback turtle). Marine turtles undertake extensive migrations and low numbers of individuals may transit through the Activity Area and are most likely to occur near the shallower seamount habitats, which may provide occasional feeding habitat.

While sea turtles are expected to pass through the Activity Area during their migration, the open oceanic conditions of the Activity Area means there are no features, such as emergent land, shallow sub-tidal features or other habitats, to support feeding or breeding grounds that will result in concentrations of these species directly adjacent to the well location. Ashmore Reef, Cartier Island and Hibernia Reef, all in excess of 280 km south west of the well location, are important feeding grounds and/or nesting sites for Green, Loggerhead and Hawksbill Turtles.

## Sea Snakes

All sea snakes in Australia are listed as protected species under the EPBC Act. The Kimberley region is noted as supporting some of the highest abundance of sea snakes anywhere off the Australian coast (Guinea and Whiting 2005).

Twenty species of sea snakes occur in the NWMR, and three are species endemic to the North West Shelf area (DSEWPaC 2013). Sea snakes are air-breathing reptiles which feed in shallow, benthic areas and are typically found in shallow inshore regions and islands however, they also occur at nearby islands and further offshore at atolls such as Scott Reef, Ashmore Reef, Cartier Island and Hibernia Reef (Guinea 2006). Only a few species of sea snake are known to inhabit deep pelagic environments, with observations indicating that most sea snakes are rarely found in depths exceeding 30 m (Cogger 1975).

A search of the EPBC Act Protected Matters database identified 12 species of sea snake that may occur in, or have habitat in, the Activity Area. The general distribution and movements of sea snakes are largely species-dependent with some species travelling large distances, while others are usually more residential to a particular area. Tagging of sea snakes at Ashmore Reef has also confirmed this, with some species remaining within the reef area for some years (Guinea and Whiting 2005).

### Marine Birds

Numerous species of birds frequent the Timor Sea area or over fly it on annual migrations. Seabird feeding grounds, roosting and nesting areas are found on the offshore atolls, particularly Ashmore Reef. Many species are listed under the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). Most seabirds breed at offshore sites, such as Ashmore Reef, Cartier Island and Browse Island, between mid-April to mid-May (Clarke 2010). Peak migration time of migratory shorebirds is between October to December (Clarke 2010).

It is expected that some individuals of these species would pass through the Activity Area during their annual migrations and may form temporary feeding aggregations, subject to the availability of food

Ashmore Reef, Cartier Island and Browse Island are important foraging areas for migratory shorebirds visiting the region from the northern hemisphere, with numbers highest between October and April (Clarke 2010). However, large numbers of shorebirds are present year round as many species ‘over winter’ in their first years of life (Australian National Parks and Wildlife Service 1989, Higgins and Davis 1996, cited in Clarke 2010).

## 4.3 SOCIAL ENVIRONMENT

### Fisheries

The North Coast bioregion of Western Australia (Pilbara/Kimberley) supports a number of commercial fisheries (Department of Agriculture, Fisheries and Forestry (DAFF 2013).

Consultation with AFMA and WA DoF confirmed that only the Northern Demersal Scalefish Fishery and North West Slope Trawl Fishery may currently operate in the title areas or in close proximity.

#### *Northern Demersal Scalefish Fishery*

The Northern Demersal Scalefish Fishery is managed by the Western Australian Department of Fisheries (DoF) and includes an extensive area adjacent to Western Australia from the Bonaparte Gulf to the west and the Pilbara to the south (DoF 2011). There are a total of 11 licences issued for the fishery and it is actively fished by five vessels based out of Broome, Pilbara and Darwin. Fish traps and lines are used to principally target high-value scalefish species such as red emperor, gold-band snapper and cod. WA DoF has advised that this fishery has the potential to have operations within or close proximity to the Activity Area but due to the low fishing effort and management measures in place no impact is expected.

#### *North West Slope Trawl Fishery*

The North West Slope Trawl Fishery (NWSTF) extends from 114°E to about 125°E off the Western Australian coast between the 200 m isobath and the outer limit of the Australian Fishing Zone (DAFF 2013). Fishing is conducted with demersal trawls along bathometric contours depending on

the target species sought. Traditionally, deepwater prawns were targeted, however, the main species currently targeted are scampi, Australiensis scampi, velvet scampi and boschmai scampi.

Fishing effort is restricted in the NWSTF by limiting the number of vessel permits. As of June 2010, there were seven permits in the fishery (DAFF 2013).

The main fishing area is more than 400 km south-east of the well locations in the waters surrounding the Rowley Shoals and Mermaid Reef. Due to the low number of active vessels, low levels of fishing activity are anticipated within the Activity Area.

## Shipping

The major commercial shipping route through the Timor Sea passes to the north of the title areas. Vessels utilising this route include bauxite carriers servicing terminals at Gove (Northern Territory) and Weipa on the Cape York Peninsula, Queensland, and coal carriers and container vessels departing Queensland ports for destinations in the Middle East, Europe and South Africa. Based on AMSA AusRep position reports for the Timor Sea there are no known recognised shipping routes through the Activity Area, although trading vessels may pass through the general area.

## Areas of Conservation Significance

### *Ashmore Reef*

Ashmore Reef, approximately 170km south west of the Activity Area, is protected by the Commonwealth managed Ashmore Reef National Nature Reserve and is also a designated RAMSAR wetland of international significance (Clarke 2010). Ashmore Reef is a large platform reef characterised by an atoll-like structure with three low, vegetated (shrubs and herbs) islands, numerous shifting sand banks and two large lagoon areas. The surrounding reef consists of a well developed reef crest most prominent on the south and east sides, and a broad reef flat. The edge of the reef flat has large areas of sand which become exposed at low tide. The islands located within the lagoon are mostly flat, being composed of coarse sand with a few areas of exposed beach rock and limestone outcrops. Ashmore Reef is internationally recognised as a significant breeding area for green turtles and also for its abundance and diversity of sea snakes (Guinea 2007). Ashmore Reef also has a high coverage of seagrass which supports a small dugong population.

### *Cartier Island*

Cartier Island, approximately 130km south west of the Activity Area and surrounding reefs are protected by the Cartier Island Marine Reserve. Cartier Island is characterised by an un-vegetated sand cay which is stabilised by patches of beach rock and surrounding mature reef flats. The effects of wind, tides and rain periodically expose and remove areas of shifting sandbanks. The island supports a large population of nesting marine turtles.

### *Hibernia Reef*

Hibernia Reef is part of the same group as Ashmore Reef and Cartier Island and is located approximately 130km southwest of the Activity Area, however, it does not form part of the Ashmore Reef and Cartier Island External Territory of Australia. Hibernia Reef is located 42 km northeast from Ashmore Reef and 62 km northwest of Cartier Island and is an oval-shaped reef that tapers to a point on the western side. While the reef has no permanent land, large areas can become exposed at low tide. Hibernia Reef is also characterised by a deep central lagoon and drying sand flats.

### *Scott Reef*

Scott Reef (North Scott Reef and South Scott Reef) is located approximately 350km southwest of the Activity Area and is listed as a Commonwealth Heritage Place, it is also listed on the Register of National Estate.

North Scott Reef is an annular reef enclosing a deep lagoon that is connected to the ocean by passages in the northeast and southwest. South Scott Reef is a crescent shaped reef which

subtends North Scott Reef and partially encloses another deep lagoon. South and North and Scott Reef are separated by a deep (400 m to 700 m) channel.

Corals communities at Scott Reef occur across shallow (<30 m) and deep (>30 m) habitats, with 306 species from 60 genera and 14 families having been identified (Gilmour *et al.* 2009).

Shallow water environments supported a higher diversity of corals (295 species) than deeper waters (51 species). Of the corals recorded, none were endemic to Scott Reef (Gilmour *et al.* 2009) and all predominantly widespread Indo–Pacific species. Coral species diversity at Scott Reef has been found to be comparable to other reefs in the region, such as Ashmore, Seringapatam and Mermaid Reef also known as Rowley Shoals, with clear affinities to coral assemblages at Ashmore Reef and the Indonesian provinces.

### *Seringapatam Reef*

Seringapatam Reef, located approximately 350km southwest of the Activity Area, is listed as a Commonwealth Heritage Place and is also listed on the Register of National Estate. Seringapatam Reef covers an area of approximately 55 km² and encloses a lagoon of relatively consistent depth of 20 m with a maximum depth of 30 m. The lagoon is connected to the ocean by a narrow passage in the northeast part of the reef (DSEWPaC 2012).

The reef is a regionally important scleractinian coral reef as it has a high biodiversity. A 2010 survey by Heyward *et al.* (2010) on the condition of shallow reef communities at Seringapatam Reef (in response to the Montara oil spill) noted that the coral cover on slopes (20-25%) and reef flats (<10%) to be similar to Ashmore Reef and Cartier Island surveyed in the same study. Mean coral abundance at 6 m depth sites across the whole reef, however, was significantly higher at Seringapatam than at either Ashmore Reef or Cartier Island.

### *Browse Island*

Browse Island, approximately 250km southwest of the Activity Area, and the waters surrounding it for a distance of three nautical miles are in WA State Territorial Waters. Browse Island is a Nature Reserve and managed by the Department of Parks and Wildlife (DPaW). The island is a sand (up to 10 m above sea level) and limestone cay situated on a limestone and coral reef. Browse Island is vegetated with herbs and low shrubs (Clarke 2010). The island represents an important marine turtle nesting site in the region for the Green turtle (*Chelonia mydas*). No seagrass communities have been observed surrounding Browse Island.

# 5 ENVIRONMENTAL RISK ASSESSMENT

An environmental hazard identification and risk assessment was undertaken using methods consistent with AS/NZS ISO 31000:2009 (AS/NZS 2009) and the PTTEP AA SSHE Risk Management Standard (SSHE-106-STD-400, Rev 3).

The key environmental hazards and control measures for the activity are presented in Appendix A. All control measures detailed in the EP will be implemented to ensure risk is managed to as low as reasonably practicable (ALARP) and will be of an acceptable level.

# 6 MANAGEMENT APPROACH

PTTEP AA is committed to proactive management of its environmental responsibilities in all its activities. The elements of the management approach include the specific systems, procedures and practices which are used to ensure that the environmental impacts and risks of the activity are reduced to ALARP and that the environmental performance objectives are met. The implementation strategy include roles and responsibilities of personnel, training and awareness of personnel, reporting framework, mitigation and emergency response arrangements, and compliance monitoring and auditing procedures.

PTTEP AA, as the operator of the activity, is responsible for ensuring the activity is managed in accordance with the accepted EP.

Environmental performance objectives, standards and criteria have been defined in the accepted EP and are monitored and reviewed to ensure effective implementation of the environmental requirements and continual improvement in achieving environmental outcomes.

All incidents that have the potential to cause significant effects on the environment will be reported and investigated according to legislative requirements, vessel procedures and the procedures laid down in the EP.

NOPSEMA will be notified of all reportable incidents within two hours of the incident first occurring (or the operator becomes aware of the incident), according to the requirements of Regulation 26 of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.*

A written report will be provided to NOPSEMA within three days of the initial notification of a reportable incident. Reportable incidents for the activity are:

- an uncontrolled release of hydrocarbons or hazardous chemicals >80L to the environment;
- an uncontrolled gaseous release to atmosphere of >300kg;
- disturbance to a particular sensitivity associated with an activity e.g. injury or death of a species of conservation value or damage to habitat of importance to those species;
- Loss of well control incident; and
- Diesel spill due to vessel collision.

# 7 STAKEHOLDER CONSULTATION

The following relevant stakeholders have been consulted via email and letter in regards to the activity during preparation of the EP with details on the location, timing and activity provided along with a request for any feedback on potential issues or concerns:

***Commonwealth Government***

Australian Fisheries Management Authority (AFMA); Australian Hydrographic Service, Department of Defence; Australian Maritime Safety Authority (AMSA); Border Protection Command; Department of Agriculture, Fisheries and Forestry (DAFF); Department of Resources, Energy and Tourism (DRET) now Department of Industry (DoI); Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (now Department of Environment (DoE)); Department of Foreign Affairs and Trade (DFAT).

***State/Territory Government***

Department of Primary Industry and Fisheries, NT; Department of Mines and Energy, NT; Department of Transport, Marine Branch (DLP Marine), NT; Department of Transport, WA; Department of Fisheries, WA; Department of Parks and Wildlife, WA.

***Responsible State/Territory Minister***

NT Office of the Chief Minister

***Organisation(s) whose functions, interests or activities may be affected***

Commonwealth Fisheries Association (CFA); NT Seafood Council; Northern Prawn Fishery; Pearl Producers Association; WA Fishing Industry Council (WAFIC); Western Australian Northern Trawl Owners Association (WANTOA); Australian Southern Bluefin Tuna Industry Association; commercial fishing operators within relevant identified fisheries; adjacent Oil & Gas operators.

***Organisation also considered relevant***

Australian Marine Oil Spill Centre (AMOSC); Recfishwest

Indigenous stakeholders are not likely to be affected by the proposed action due to the distance offshore and absence of any Indigenous sites of significance Therefore, consultation has not, and is unlikely to, be undertaken with Indigenous stakeholders.

PTTEP AA will continue to consult with the above listed organisations in response to any issues that may be raised. Consultation with all of the stakeholders listed above, plus additional others identified during the consultation process, will continue prior to and during the activity if necessary.

# 8 CONTACT DETAILS

Further details on the activity can be obtained from:


| | |
|---|---|
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# APPENDIX A: ENVIRONMENTAL RISK ASSESSMENT SUMMARY

| ROUTINE/ PLANNED ACTIVITIES | | | |
|---|---|---|---|
| **Hazard** | **Impacts** | **Control and Mitigation Measures** | **Residual Risk** |
| **Socio-Economic** | | | |
| Presence of the MODU safety exclusion zone. Interference with commercial fisheries and shipping activities | Potential for obstruction to fishing and shipping operations due to presence of exclusion zone around the MODU (loss of access to fishing ground). Economic costs to fisheries. | Consultation with the Commonwealth and State management authorities, and with specific fisheries and shipping operators as identified through consultation;<br>All mariners alerted to exclusion zone/MODU presence; and<br>MODU and support vessels are equipped with navigation aids and required lighting specification.<br>No infrastructure left on the seabed on completion of the activity. | Low |
| **Disturbance to Marine Environment** | | | |
| Potential for the physical presence of the MODU and associated support vessels and helicopters to interact with marine fauna | Potential changes in faunal behavior and/or physiology due to MODU presence and vessel activity, such as avoidance behaviour, increased dive times, stress behaviour. | Implementation of the EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans:<br>▪ Support vessels will not travel greater than 6 knots within 300 m of a whale and approach no closer than 100 m from a whale<br>▪ Helicopters shall not operate lower than 500 m or within the horizontal radius of 500 m of a whale known to be present in the area. | Low |
| Introduction of invasive marine species via biofouling and/or ballast water from MODU and support vessels | IMS can impact on native populations/fauna populations – increase competition for resources and habitat; predation of native/endemic species/food sources and can impact on human uses/resources (e.g. biofouling). | MODU and all vessels will have AQIS clearance prior to mobilisation to well location.<br>MODU and all vessels will have valid antifouling certification prior to mobilisation<br>MODU and support vessels will adhere to AQIS Australian Ballast Water Management Requirements including foreign ballast water exchanges conducted more than 12nm from land and in water depths greater than 200m. | Low |
| Disturbance to marine fauna from light emissions from MODU and support vessels deck lighting | Light spill on to ocean attracting seabirds, fish, turtles and other sea life - causes disruption to natural behavior patterns (e.g. foraging) | All lighting will be maintained as required for vessel navigation and safe deck operations<br><br>Compliance with 'Drilling Management System' PTTEP AA, Standard ID D41-502432-FACCOM, Basis of Well Test Design & Well Cleanup Program procedures that ensures the minimum flaring undertaken to adequately test the well. | Low |
| Seabed disturbance from anchors and anchor chains mooring the MODU | Disturbance to seabed or epifauna causing damage or loss of habitat, Localised loss, disturbance and/or smothering of seabed features and | Use of site survey data to identify seabed features to be avoided by anchors<br>Adherence to rig move procedures to minimise potential impacts on the seabed<br>ROV survey undertaken at well locations to confirm seabed features/debris prior to positioning the MODU and upon MODU demobilisation to confirm no debris left on | Low |

| ROUTINE/ PLANNED ACTIVITIES | | | |
|---|---|---|---|
| **Hazard** | **Impacts** | **Control and Mitigation Measures** | **Residual Risk** |
| | benthic habitat. Reduction in water quality (i.e. Total Suspended Solids) | seabed; | |
| Anthropogenic Noise from MODU, support vessels, helicopters and airgun during VSP | Disturbance to marine fauna, mammals and fish; possible physical damage to immobile plankton such as fish eggs and larvae in immediate proximity to MODU.<br>Potential behavioural changes in fish and marine mammals due to increase in background marine noise levels. Possible localised avoidance/ attraction. | MODU preventative maintenance program implemented to optimise the efficiency of equipment;<br>Implementation of the EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans;<br>• Support vessels will not travel greater than 6 knots within 300 m of a whale and approach no closer than 100 m from a whale;<br>• Helicopters shall not operate lower than 500 m or within the horizontal radius of 500 metres of a whale known to be present in the area<br>Vertical Seismic Profiling (VSP) is a short term operation and noise generated will be managed in accordance with EPBC Policy 2.1<br>• Observe a 3km precautionary zone, a 1km low power zone and 500m shutdown zone; and<br>• Undertake a 30-minute pre-start-up visual observation soft start, sequentially ramp up the acoustic source (soft start) over a 30-minute period. | Low |
| **Discharges to Atmosphere** | | | |
| Power generation from MODU and support vessels producing atmospheric emissions: Increase in greenhouse effect. | Power generation by the MODU and fuel use by support/supply vessels and helicopters releases combustion products to the atmosphere.<br>These emissions may contribute to global warming (CH4, CO2); acid effects (SOx, NOx). There may be the potential for localised smog formation. | Engines maintained to operate at optimum efficiency to minimise emissions;<br>Power generation equipment to be regularly maintained and operated in compliance with contractors scheduled maintenance program;<br>Support vessels and the MODU will have IAPP Certificates validating conformance to the requirements of MARPOL Annex IV including use of low sulfur diesel;<br>GHG emissions recorded and reported in accordance with PTTEP AA Energy and Emissions Estimation Manual (S32-505264-CORP) | Low |
| Flaring during well testing producing atmospheric emissions: Increase in greenhouse effect. | Release of combustion products to the atmosphere. May contribute to global warming (CH4, CO2), acid effects (SOx, NOx). Potential for localised smog formation. | Compliance with 'Drilling Management System' PTTEP AA, Standard ID D41-502432-FACCOM, Basis of Well Test Design & Well Cleanup Program procedures that ensures the minimum flaring undertaken to adequately test the well. | |
| **Waste Management** | | | |
| Generation and disposal of | Potential pollution to the marine | PTTEPAA Waste Management Plan will be in place to ensure: | Low |

| ROUTINE/ PLANNED ACTIVITIES | | | |
|---|---|---|---|
| **Hazard** | **Impacts** | **Control and Mitigation Measures** | **Residual Risk** |
| non-hazardous waste from MODU and supply vessels | environment; injury and entanglement of marine fauna and seabirds; onshore litter; landfill | ▪ Minimisation of the amounts of non-hazardous wastes generated at source;<br>▪ Segregation of waste by type;<br>▪ Storage in covered skips to prevent emissions and leaks.<br>▪ Recycling or re-use prioritised where possible<br>▪ Use of licensed waste contractors and disposal facilities. | |
| Generation and disposal of hazardous waste from MODU and supply vessels | Potential pollution to the marine environment; deterioration in water quality; landfill | PTTEPAA Waste Management will be in place to ensure:<br>▪ Minimisation of the amounts of hazardous waste generated at source;<br>▪ MSDS available onboard;<br>▪ Segregation of waste by type;<br>▪ Storage in covered skips to prevent emissions and leaks;<br>▪ Recycling or re-use prioritised where possible, in particular for scrap metal, waste oil and surplus chemicals;<br>▪ Use of licensed waste contractors and disposal facilities; and<br>▪ SBM sent onshore for reconditioning/disposal by the manufacturer. | Low |
| **Discharges to the Marine Environment** | | | |
| Discharge of putrescible wastes, sewage and grey water to marine environment from MODU and supply vessels | Fish and other sea life attracted to food source. Impacts on water quality and changes in fauna behaviour leading to short term impacts on local populations. Plastic waste can cause harm/injury to marine fauna. | All waste treatment systems comply with MARPOL requirements (Annex V – Regulation 3; all food scraps and putrescible wastes comminuted to <25 mm prior to discharge); and<br>Offshore discharge will be released at least 12 nm from land and putrescible waste will be macerated to less than 25 mm prior to discharge.<br>Compliance with MARPOL Annex IV – Regulations 8 & 11, any discharges to be made through an IMO type-approved sewage treatment plant and no untreated sewage discharged within 12 nautical miles of land. | Low |
| Discharge to marine environment – deck drainage and bilge water from MODU and supply vessels | Degradation of water quality | Deck drainage from bunded areas will be directed to an oil-water separator;<br>Absorbents and containers available on the MODU and all support vessels to clean up small accumulations of oil and grease around work areas and decks;<br>Oily water from machinery space bilges will be captured and directed to a bilge holding tank which is sent to the OWS and discharge will not exceed 15 mg/l | Low |
| Discharge to marine environment – cooling water from MODU | Temporary and localised increases in sea water temperatures resulting in physical effects (e.g. injury or death) to marine biota. | Cooling water system maintained to ensure efficient operation.<br>The cooling water system is a segregated system, with no hydrocarbons or chemical content | Low |

| ROUTINE/ PLANNED ACTIVITIES | | | |
|---|---|---|---|
| **Hazard** | **Impacts** | **Control and Mitigation Measures** | **Residual Risk** |
| Discharge to marine environment –brine from MODU | Temporary and localised increases in salinity resulting in potential toxic effects on marine biota. | Dilution of brine discharge via discharge with cooling water. | Low |
| Discharge to marine environment – WBM coated drill cuttings | Low levels of chemicals released; increased localised turbidity; potential depletion of oxygen in surface sediments; possible loss of seafloor habitat. Potential cumulative increase to background contaminant levels and loss of biodiversity. | Use of CHARM Gold or Silver or OCNS Category E of D environmentally rated chemicals require no further assessment. If other rated or non- rated chemicals are required the chemical(s) will be assessed for acceptability before use<br>Recovered WBM will be reused/re-circulated where practical and cuttings/mud cleaning equipment will ensure optimal cuttings cleaning prior to discharge | Low |
| Discharge to marine environment – SBM coated drill cuttings | Low levels of chemicals released; increased localised turbidity; potential depletion of oxygen in surface sediments; possible loss of seafloor habitat. Potential cumulative increase to background contaminant levels and loss of biodiversity. Leaching of chemicals adhered onto drill cuttings. | No whole Synthetic Based Muds (SBM) will be discharged overboard. Any unused or recovered SBM will be shipped back to shore for inspection by the mud systems contractor. If the recovered SBM does not meet the minimum standard to enable reuse, following onshore treatment, the SBM will be disposed at an authorised landfill site.<br>No more than an average of 10% of SBM (dried weight) on cuttings remains prior to discharge.<br>Third party inspection of the MODU's mud mixing and circulating system, cuttings dryer, shale shakers and centrifuges, drain system, valve arrangements and cuttings dryer interfaces prior to MODU mobilisation.<br>Third party monitoring of mud handling equipment and compliance with maximum 10% SBM on discharged cuttings;<br>Compliance with the PTTEP AA Approval and Control of Hazardous Substances Management Standard (S32-501162-CORP) for selection/risk assessment of chemicals to be used:<br>Use of CHARM Gold or Silver or OCNS Category E or D environmentally rated chemicals require no further assessment. If other rated or non- rated chemicals are required the chemical(s) will be assessed for acceptability before use.<br>Only the production casing sections of the wells will be drilled with SBM. | Low |
| Discharge to marine environment - cement | Possible smothering of seabed around the well site by discharged cement slurry. Potential depletion of oxygen in surface sediments; possible loss of seafloor habitat or toxic effect. | Cement and associated chemicals will be mixed offshore as needed to minimise quantities for disposal<br>Subsea ROV inspection during cementing operations will ensure that excess returns to the seabed are minimized<br>Cement additives of Gold or E environmental rating will be used | Low |

| NON-ROUTINE/UNPLANNED ACTIVITIES | | | |
|---|---|---|---|
| **Hazard** | **Impacts** | **Control & Mitigation Measures** | **Residual Risk** |
| **Discharges to Atmosphere** | | | |
| Accidental release of Ozone Depleting Substances from MODU or supply vessels | Localised effect on air quality; emissions may contribute to ozone depletion | ODS inventory maintained in compliance with MARPOL Annex VI (Regulation 12); and<br>MODU personnel licensed for handling ODSs. | Low |
| **Discharges to Marine Environment** | | | |
| Accidental release of chemicals or non-hazardous/hazardous waste discharge from MODU and vessels during general operations and bulk transfers (spills/leaks) | Pollution from waste products leading to deterioration in water quality.<br>Potential for impacts to fauna due to ingestion or entanglement of plastics<br>Pollution from hazardous waste products and potential for spills and leaks of SBM, oils or hydraulic fluids which may cause localised toxicity effects on marine life and deterioration in water quality. | Implementation of PTTEPAA Waste Management Plan including compliance with MARPOL requirements, waste log maintained, secure storage and correct segregation of solid and hazardous wastes in all areas on the MODU and support vessels;<br>Implementation of MODU hazardous substances procedures to ensure:<br>• Vessels maintain a file containing the Material Safety Data Sheets (MSDS) for all hazardous chemicals carried aboard;<br>• Copies of the relevant MSDS are also kept in the spaces where these chemicals are stored or handled;<br>• All chemicals are in appropriate containers and clearly marked;<br>• Designated containment areas onboard for oil, grease and chemical storage;<br>• Clean up materials will be available on the MODU and vessels to manage small deck spills;<br>• Minimal amounts of hazardous wastes & only operationally required amounts of hazardous materials to be stored onboard;<br>Transfer operations will be supervised at all times from both the supply boat and the MODU; transfer of hydrocarbons only undertaken in daylight and good weather conditions. All other transfers (chemicals/SBM) only undertaken during good weather conditions;<br>Equipment to be regularly maintained and operated in compliance with contractors scheduled maintenance program to detect spills or leaks from fittings and connections;<br>MODU and support vessels SOPEP that includes procedures for minimising losses to sea. | Low |
| Loss of hydrocarbons during vessel and MODU refuelling diesel spill (max 5m$^3$) | During bunkering operations on the MODU there is the potential for fuel line failure/leaks from hoses which may cause localised toxicity or | MODU and support vessels SOPEP that includes procedures for minimising losses to sea.<br>Refuelling to be carried out under MODU specific refueling procedures to ensure zero | Low |

| NON-ROUTINE/UNPLANNED ACTIVITIES | | | |
|---|---|---|---|
| **Hazard** | **Impacts** | **Control & Mitigation Measures** | **Residual Risk** |
| | smothering effects on marine fauna and flora. | refueling incidents | |
| Vessel Collision<br>- Rupture of fuel tank and large diesel spill at sea (maximum 80 $m^3$) | Reduced water quality and associated biological community impact with potential for damage to sensitive resources.<br>Impacts on water quality and marine fauna in the affected area.<br>Physical presence of MODU presents a navigational hazard, potential for collision. | Adherence to standard maritime safety and navigation requirements to prevent collisions including:<br>▪ IMO International Regulations for Preventing Collisions at Sea (COLREGS)<br>▪ Issuance of Notice to Mariners<br>▪ Auscoast warnings via AMSA and MSA Rescue Coordination Centre notified<br>▪ MODU and support vessels are equipped with sophisticated navigation aids and competent crew maintaining 24 hour visual, radio and radar watch for other vessels<br>▪ Radio warnings to mariners as required<br>▪ Approved vessel SOPEP and assistance from PTTEP AA Oil Spill Contingency Plan (OSCP) and Emergency Management Team (EMT)<br>▪ Support vessel in constant attendance of the MODU<br>▪ Support vessel cannot enter 500m zone without permission from MODU<br>▪ Safety exclusion zone (500m).<br>SOPEP procedures comply with MARPOL 73/78:<br>▪ Sufficient spill response equipment to prevent spills on deck reaching the environment<br>▪ Procedures to be followed to minimise losses to sea | Medium |
| Uncontrolled well flow during drilling<br>Condensate - maximum 95,392$m^3$ over 80 days | Physical oiling and toxicity impacts to marine fauna and flora.<br>Indirect impacts could include: habitat loss, impact on tourism and fisheries, issue of waste disposal<br>Accumulation of oil and chemicals in the food chain and in sediments. | Compliance with PTTEP AA Drilling Management System, Well Integrity Manual (D41-504807-FACCOM), applicable WOMP & Blow Out Contingency Plan (IC-DR-D41-80550).<br>Response undertaken in accordance with the NOPSEMA accepted Cash Maple Drilling Program OSCP including response and environmental monitoring arrangements | Medium |