Shell Australia Pty Ltd
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Prelude FLNG
Environment Plan Summary

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1. Introduction

Shell Australia Pty Ltd (Shell) proposes to develop, install and operate the Prelude Floating Liquefied Natural Gas (FLNG) Project in the Petroleum Permit Area WA-44-L.

The Prelude FLNG project is located in the northern Browse Basin, approximately 475k north-north east of Broome and over 200 km from the nearest point on the Kimberley coast. Shell is the Operator of Prelude FLNG in joint venture with INPEX (17.5%), KOGAS (10%) and OPIC (5%). The project enables natural gas to be extracted, processed, liquefied, stored and transferred at sea. The Prelude Floating LNG Facility is expected to produce 3.6 million tonnes per annum (mtpa) of LNG, 1.3 mtpa of condensate and 0.4 mpta of LPG.

The entire Prelude FLNG Project was referred by Shell under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (EPBC 2008/4146) and was determined by the then Department of Environment, Water, Heritage and the Arts (DEWHA) to be a 'controlled action' on 7th May 2008.

DEWHA determined that the proposed Prelude FLNG Project would be assessed by an Environmental Impact Statement (EIS). This EIS was prepared and submitted to DEWHA in July 2009. The EIS covered development drilling; installation of subsea facilities; and, FLNG hook-up, commissioning, operation and maintenance and decommissioning. The project received its environmental approval on the 12th November 2010 from the then Federal Environment Minister and then Department of Sustainability, Environment, Water, Population and Communities (now Department of Environment, DoE).

In accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, Shell Australia, as titleholder and operator of the WA-44-L permit, has prepared the Environment Plan for the installation and operation of the Prelude FLNG facility, which was accepted on 7th December 2016.

This Environment Plan summary has been prepared in accordance with the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations (2009) and with reference to N-04750-GL1566 Environment Plan Summaries Guideline (NOPSEMA, 13 July 2016).

2. Description of the Activity

2.1. Scope of the EP

The EP covers the following Prelude project activities within permit area WA-44-L and infrastructure license WA-2-IL:

- Arrival of the FLNG facility to WA-44-L, offshore installation of the FLNG facility and commissioning, start-up, operations and maintenance of the FLNG facility and the subsea structure;
- The operation of support vessels and helicopters within the safety zone around Prelude FLNG facility;
- Well intervention activities using a light well intervention vessel;
- Product transfer from FLNG to carriers and associated berthing activities.

2.2. Location of the Activity

The Prelude FLNG Project is in WA-44-L, in Commonwealth marine waters, 200km offshore mainland northwest Australia and 475km north-north east of Broome (Figure 1), in 237m from Mean Sea Level (MSL) water depth.

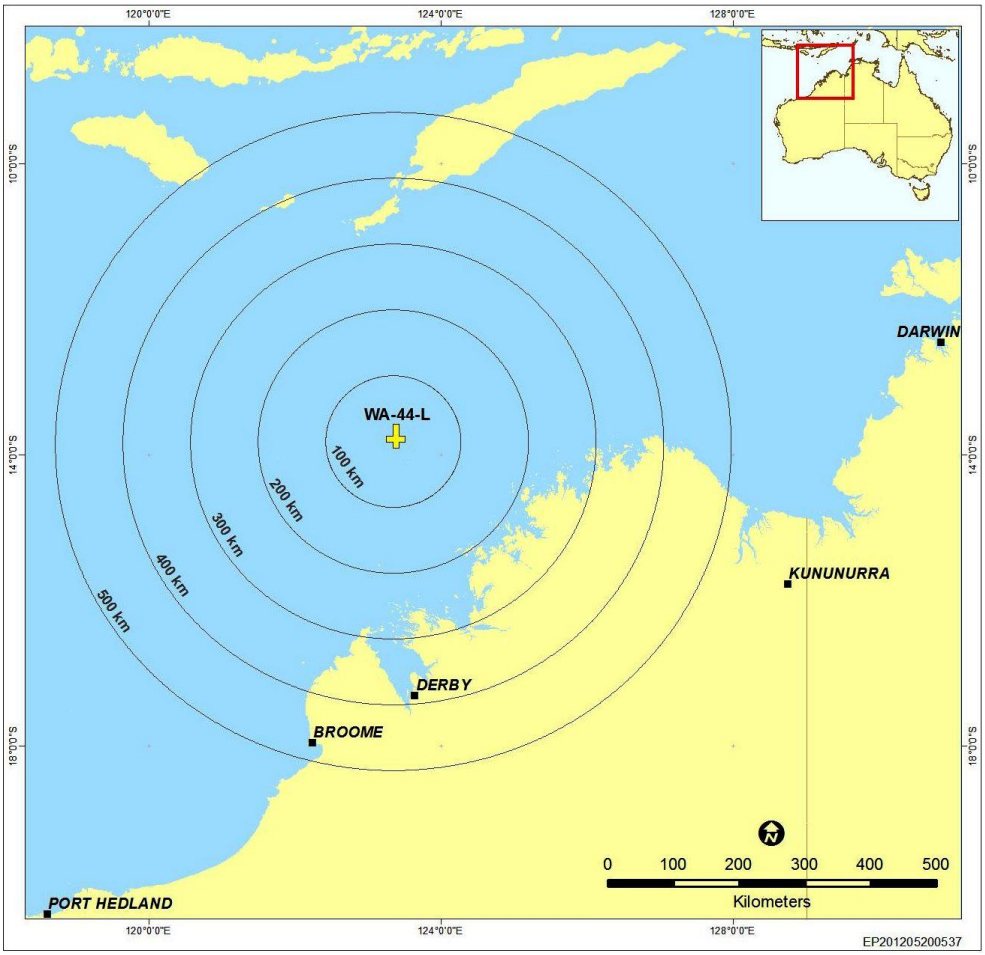

Figure 1: Location of Prelude (Permit Area WA-44-L)

The Prelude field Safety Zone extends around both the subsea and well infrastructure equipment and the Prelude FLNG as shown in Figure 2.

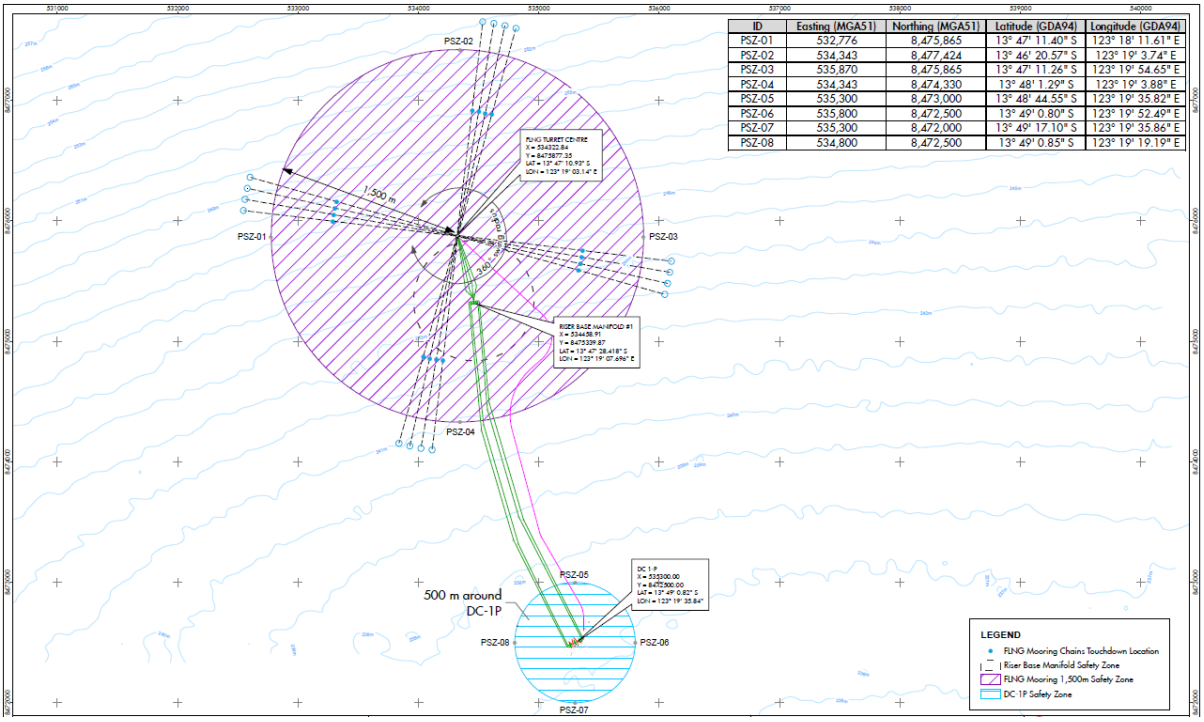

Figure 2: Prelude Field Layout and Safety Zone Diagram

2.3. Prelude FLNG Facility Overview

The Prelude FLNG Project comprises the Prelude FLNG facility itself and subsea equipment including: production wells; christmas trees; manifolds; flowlines; the riser base manifold; flexible risers and an umbilical and subsea distribution system providing hydraulics, power, communications and chemical services to the subsea wells and subsea manifolds (Figure 3).

The Prelude FLNG development has one drill centre with two 6-slot manifolds and 7 production wells (base case) located 3km south of the Prelude FLNG. The Prelude FLNG is connected to the gas reservoir via 12" flowlines and flexible risers routed to the turret. One umbilical links the Prelude FLNG facility to the subsea field. This umbilical provides hydraulic, electrical and chemical services to enable control / communication with the subsea equipment. The umbilical also incorporates fibre optic elements that are used as one means of communication transfer to/from onshore.

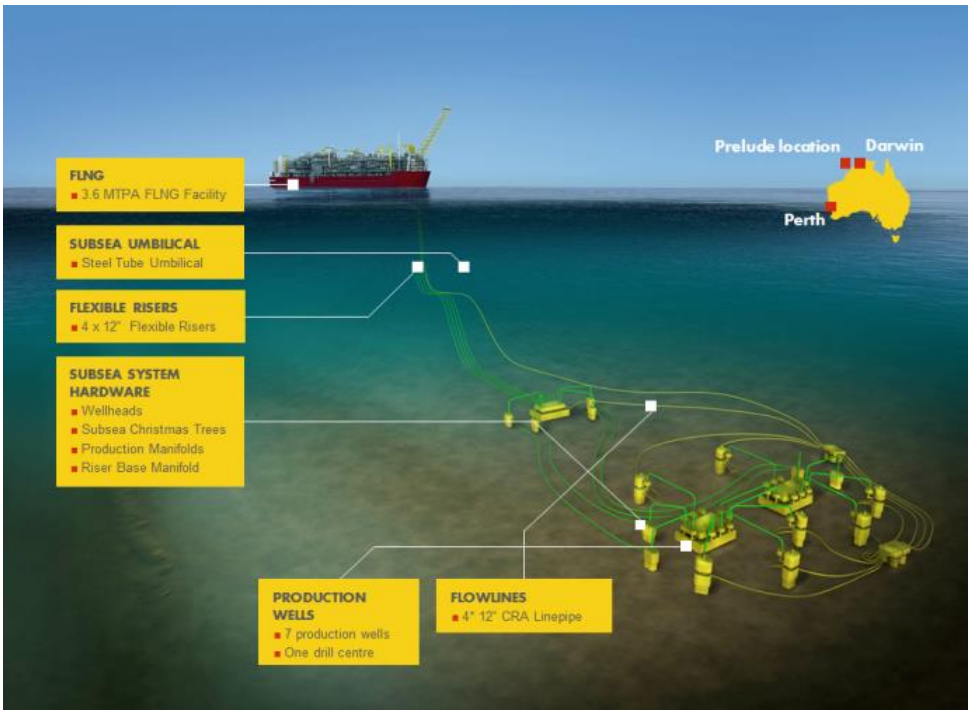

Figure 3: Prelude FLNG Project

The FLNG facility itself is approximately 488m long and 74m wide, and permanently moored at the gas field location during the period of production. The Prelude FLNG is designed to remain on station and manned at all times. The FLNG facility has been designed for a field life of 25 years. The Prelude FLNG is moored in water approximately 240m deep using 16 mooring lines connected to piles grouped into 4 quadrants, and is capable of producing LNG, Liquid Petroleum Gas and Condensate for export.

The processing and liquefaction of gases and condensate occurs in the Topsides modules. Shell's Dual Mixed Refrigerant (DMR) process is used to liquefy the gas. Prelude's LNG and LPG will be offloaded via a side-by-side vessel configuration using cryogenic loading arms. Ships will load condensate from the rear of the facility using a floating hose arrangement. The products will then be shipped directly to customers.

The FLNG facility includes LNG, LPG and condensate storage as well as facilities for exporting these products to carriers. All reservoir, subsea control, processing, storage and loading functions are operated from the FLNG facility.

The main elements of the FLNG facility are:

- An internal turret, permanently mooring the FLNG facility to the sea-bed via a catenary mooring system & provides interface with production risers and umbilical;
- Production risers systems;
- Topsides containing all process units & part of the utilities systems;
- Living Quarters, helideck and helicopter operation facilities;
- A substructure with all necessary marine facilities, cargo containment systems, and part of the utilities systems and waste water treatment package;
- Offloading facilities which include the marine loading arms, condensate loading reel and offloading mooring connections;
- Water intake risers delivering cold seawater to meet process cooling requirements.

The substructure is separated from the topsides by the main deck, on which piping systems such as cooling water, steam, fuel gas, rundown and loading lines are located. Topsides equipment is arranged in large modules over a series of process decks.

2.4. Installation, Hook-up and Commissioning and Start-up Activities

The Prelude FLNG facility is expected to arrive in field during 2017. On arrival at location, support tugs will be configured into a holding pattern to position the Prelude FLNG on station. Pre-installed mooring lines are recovered from the seabed and connected to the facility. Once Prelude FLNG is moored, installation and tie-ins of the production risers and umbilicals and water intake riser will be carried out.

Testing and commissioning of the subsea systems and facility systems will then be conducted. LNG and LPG import will occur during this phase for use in the testing, commissioning and start-up of the LNG and LPG tanks and process system, and to switch the boiler operations from diesel to fuel gas. An accommodation support vessel may be bridge linked to the FLNG facility during the installation and commissioning period to accommodate the extra workforce required during this period.

After commissioning has been completed, start-up and ramp-up of production will occur until steady-state operation is achieved. Steady state operation is defined as the facility reaching and maintaining steady operation at design capacity.

2.5. FLNG Facility Maintenance

Regular maintenance activities on the FLNG facility will be executed by Shell and the Facilities Maintenance Contractor, utilising spared equipment to allow maintenance without interrupting production. Major maintenance turnarounds will require complete or partial facility shutdowns and are expected every 4 years. Temporary facilities for additional personnel, wastes accumulated and materials may be required during major turnarounds, however, no significantly different environmental risks from normal operations are expected.

2.6. Maintenance of Subsea Equipment

Subsea equipment has been designed to limit the required amount of maintenance. However, regular inspection will be carried out as required to ensure the integrity of the infrastructure and to identify any maintenance needed before they present a risk of loss of containment or asset damage.

The majority of maintenance activities comprise inspections using subsea remote operated vessels (ROVs) for cathodic protection probe inspection and checks, marine growth checks, seabed and free span monitoring, azimuth and mooring surveys.

2.7. Well Intervention and Work-over

Well intervention activities can be initiated by a number of scenarios that may occur during the operations phase of a well's lifecycle. Interventions may be undertaken for reservoir surveillance, enhancing productivity, assessing wellbore condition and restoring well integrity. Well interventions may include wellhead maintenance, logging or surveys, preventing safety critical failures and connecting the wellbore to the reservoir.

2.8. Logistic Support Arrangement

2.8.1. Aviation Support Location

Prelude requires logistics support from the mainland of Australia. The primary means of mobilising personnel to the facility is by helicopter from Broome.

2.8.2. Infield Support Vessel

Three Infield Support Vessels (ISVs) support the operations of the Prelude FLNG facility with typically two of the ISVs present in the field at all times. The ISVs are multi-role, firstly fulfilling the role of Standby Vessels and secondly supporting product (LNG/LPG/condensate) carrier berthing/mooring and unberthing operations. The ISVs also serve a role as security surveillance vessels and for initial response in the event of a spill.

2.8.3. Supply Vessel(s)

Up to four supply vessels are planned to be utilised during the installation and hook-up activities. In addition, further logistic support will be provided by the Contractors dedicated for delivering scope associated to the offshore hook-up, installation and commissioning activities.

During normal operations a Multi-Purpose Supply Vessel (MPSV) will provide the logistics support to the FLNG facility. The scope of work for the MPSV includes:

- Port operations (Loading / discharging of cargo and specialist equipment);
- The safe transportation of cargo / equipment to and from the FLNG facility;
- Offshore Installation operations (Discharging / back-loading of cargoes and specialist equipment);
- Conducting subsea inspection and intervention activities.

3. Description of the Receiving Environment

3.1. Physical

The permit area, WA-44-L, is located in waters on the continental slope between 200 and 300m water depth. There are no significant topographical features in the region of the Prelude project area. No reefs or extensive areas of rocky substrate have been observed. Sediments at the Prelude field are described as very soft siliceous carbonate silts to a depth of about 10m below the seabed where siliceous carbonate sands are found.

The most sensitive seabed features in the broader Browse Basin are the coral reefs and islands that occur in the region. The closest of these features, Browse Island, is located some 40km south-southeast of the Prelude location. Due to the distance of Prelude from these features, none are affected by any planned activities associated with the Prelude project, but could potentially be affected by unplanned situations which will be managed as discussed in Section 4.

Significant land masses north (>200km) of WA-44-L include Timor Island and the Southern Indonesian Archipelago. Areas of coastal ecosystems within the Indonesian and Timor Island region are characteristic of coastal tropical environments and show similar features to that of Australia's North West coast.

3.2. Biological

3.2.1. Benthic and Pelagic Communities

In the general region of WA-44-L, at ~237m depth, there is little evidence of hard substrates and extensive epibenthic communities. Thus, with little sea floor topography, such areas offered minimal habitat diversity or niches to occupy. Specifically, the absence of hard substrate is considered a limiting factor for the recruitment of epibenthic organisms (Heyward & Smith 1996).

3.2.2. Endangered and Vulnerable Species

The Environment Protection Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Database does not list any Threatened Ecological Communities occurring in the marine environment. The database lists nine Threatened Species that potentially transverse WA-44-L, which does not contain any recognised feeding, breeding or aggregation areas. Threatened species listed include two cetacean species, six reptile species and one shark species.

Table 1: Threatened Species that may transit through WA-44-L

Scientific Name	Common Name	EPBC Act Status
Cetaceans		
Megaptera novaeangliae	Humpback Whale	Threatened (Vulnerable)*
Balaenoptera musculus	Blue Whale	Threatened (Endangered)*
Reptiles		
Natator depressus	Flatback Turtle	Threatened (Vulnerable)*
Chelonia mydas	Green turtle	Threatened (Vulnerable)*
Dermochelys coriacea	Leatherback Turtle	Threatened (Endangered)*
Eretmochelys imbricata	Hawksbill Turtle	Threatened (Vulnerable)*
Lepidochelys olivacea	Olive Ridley Turtle	Threatened (Endangered)*
Caretta caretta	Loggerhead Turtle	Threatened (Endangered)*
Fish and Sharks		
Rhincodon typus	Whale Shark	Threatened (Vulnerable)*

*Also listed as Migratory

The EPBC Act Protected Matters Database also lists sixteen species covered by the migratory provisions of the Act that may occur within the WA-44-L. Migratory species that may occur within the WA-44-L permit area include six cetacean species, one species of bird, six reptile species and three fish / shark species.

Table 2: Migratory species that may occur within WA-44-L

Scientific name	Common name
Birds	
Calonectris leucomelas, Puffinus leucomelas	Streaked Shearwater
Mammals	
Balaenoptera bonaerensis	Antarctic minke whale
Balaenoptera edeni	Bryde's whale
*Balaenoptera musculus**	Blue whale*
*Megaptera novaeangliae**	Humpback whale*
Orcinus orca	Killer whale
Physeter macrocephalus	Sperm whale
Reptiles	
*Caretta caretta**	Loggerhead turtle*
*Chelonia mydas**	Green turtle*
*Dermochelys coriacea**	Leatherback turtle*
*Natator depressus**	Flatback turtle*
*Lepidochelys olivacea**	Olive ridley*
*Eretmochelys imbricate**	Hawksbill turtle*
Fish and Sharks	
Isurus oxyrinchus	Shortfin mako
Isurus paucus	Longfin mako
*Rhincodon typus**	Whale shark*

* Also identified as a Threatened Species

3.3. Key Ecological Features

A number of key ecological features (KEF) have been identified near WA-44-L. KEFs are elements of the Commonwealth marine environment that are considered to be of regional importance for either a region's biodiversity or its ecosystem function and integrity (Commonwealth of Australia [CoA], 2011). A summary of the KEFs in the North-West region is listed in Table 3 below.

Table 3: Key Ecological Features within the ZPI

KEF	Summary of KEF's Regional Importance
Ancient coastline at 125 m depth contour	• Parts of the ancient coastline, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. • The topographic complexity of these escarpments may also facilitate vertical mixing of the water column providing a relatively nutrient-rich environment for species present on the escarpment.
Ashmore Reef and Cartier Islands and surrounding Commonwealth waters (Ramsar Site – Wetland of International Importance)	• Ashmore Reef is the largest of only three emergent oceanic reefs present within the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. Emergent reefs are areas of enhanced primary productivity in an otherwise oligotrophic environment. • Ashmore Reef and Cartier Islands and the surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of seabirds and shorebirds, and other marine life. • Ashmore Reef supports the highest number of coral species of any reef off the Western Australian coast. • The marine habitats among the reefs are nationally and

KEF	Summary of KEF's Regional Importance
	internationally significant supporting diverse and abundant marine reptile and mammal populations, including dugong. • Ashmore is the largest of the atolls in the Timor Province bioregion. The three islands within the site are also the only vegetated islands in the bioregion. Each of the wetland types present are in near natural condition and the site has the largest seagrass coverage in the bioregion. • Ashmore Reef plays a primary role in the maintenance of biodiversity in reef systems in the region. • The Ramsar site is also important for feeding for green turtles, hawksbill turtle and loggerhead turtle and critical nesting and inter-nesting habitats for green and hawksbill turtles. • Ashmore Reef regularly supports more than 20 000 waterbirds and has been known to support more than 65 000 waterbirds. • The Ramsar site regularly supports more than one per cent of at least six species of waterbird including the sooty tern, bar-tailed godwit, grey-tailed tattler, ruddy turnstone, sanderling and greater sand plover.
Canyons linking the Argo Abyssal Plain with Scott Plateau	The canyons linking the Argo Abyssal Plain and Scott Plateau are likely to be important features due to their historical association with sperm whale aggregations.
Carbonate bank and terrace system of the Sahul Shelf	The carbonate banks and terrace system of the Sahul Shelf are regionally important because of their role in enhancing biodiversity and local productivity relative to their surrounds. Little is known about the banks, terraces and associated channels but they are believed to be areas of enhanced productivity and biodiversity due to the upwellings of cold nutrient-rich water at the heads of the channels.
Continental slope demersal fish communities	The diversity of demersal fish assemblages on the Australian continental slope from North West Cape to the edge of the region is high. Specifically, the continental slope between North West Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in the whole of Australia. The Timor Province and Northwest Transition bioregions are the second-richest areas for demersal fish across the entire continental slope.
Glomar Shoals	The Glomar Shoals are a submerged littoral feature located approximately 150 kilometres north of Dampier on the Rowley shelf at depths of 33–77 metres (Falkner et al. 2009). The Glomar Shoals are regionally important for their high biological diversity and high localised productivity. Biological data specific to Glomar Shoals is limited; however, the fish of Glomar Shoals are probably a subset of reef-dependent species and anecdotal and fishing industry evidence suggests they are particularly abundant. It is known to be an important area for a number of commercial and recreational fish species such as rankin cod, brown-striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Fletcher & Santoro 2010).
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals are regionally important in supporting high species diversity, enhanced productivity and aggregations of marine life. • The reefs have biogeographic value due to the presence of species which are at or close to the limit of their distribution. The coral communities are one of the special values of Mermaid Reef.
Pinnacles of the Bonaparte Basin	The limestone pinnacles in the western Bonaparte Depression are likely to be of important conservation value as they are expected to support a diverse community in an otherwise oligotrophic system. More

KEF	Summary of KEF's Regional Importance
	than 110 pinnacles occur in the Bonaparte Depression, covering a total area of more than 520 square km.
Seringapatam Reef and Commonwealth waters in the Scott Reef complex	Seringapatam Reef and Commonwealth waters in the Scott Reef complex are regionally important as they support diverse aggregations of marine life, have high primary productivity relative to other parts of the region, are relatively pristine and have high species richness.

3.4. Marine Reserves

A search of the EPBC Protected Matters Database (DOE, 2011b) identified that WA-44-L is not located in any Marine Protected Areas.

The Ashmore Commonwealth Marine Reserve is located ~ 160 km from the project area at the closest point. In 2003, the Ashmore Reef National Nature Reserve was declared a Ramsar Wetland of International Importance due to the importance of its islands providing a resting place for migratory shorebirds and supporting large seabird breeding colonies. Ashmore Reef has a high diversity of reef building and non-reef building corals, approximately 11,000 turtles including significant populations of green, loggerhead and hawksbill turtles (DOE, 2013b).

The Cartier Commonwealth Marine Reserve is located 45 km south-east of Ashmore Reef. It is internationally significant for its abundance and diversity of sea snakes and significant feeding populations of green, hawksbill and loggerhead turtles that occur around the reefs. (DOE, 2013h). Ashmore Reef and Cartier Island and the surrounding Commonwealth waters are recognised as regionally important for feeding and breeding aggregations of birds and other marine life as they are areas of enhanced primary productivity in an otherwise low-nutrient environment (DOE, 2013h).

The Kimberly Commonwealth Marine Reserve is located about 130km SE of the Prelude location at its closest point. It is important foraging areas for:

- migratory seabirds, migratory dugongs, dolphins and threatened and migratory marine turtles;
- Important migration pathway and nursery areas for the protected humpback whale;
- Adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles;
- The reserve provides protection for the communities and habitats of waters offshore of the Kimberley coastline ranging in depth from less than 15 metres to 800 metres;
- Continental shelf, slope, plateau, pinnacle, terrace, banks and shoals and deep hole/valley seafloor features are all represented in this reserve;
- Two key ecological features are included in the reserve:
  - ancient coastline (an area of enhanced productivity attracting baitfish which, in turn, supplies food for migrating species)
  - continental slope demersal fish communities (the second richest area for demersal fish species in Australia)
- Adjacent to the National Heritage values of the West Kimberley.

The Argo Rowley Terrace Commonwealth Marine Reserve multiple use zone is located approximately 300 km from WA-44-L at the closest point. It is comprises 83,379 km^2 of Multiple Use Zone - IUCN Category VI and 62,720 km^2 of Marine National Park Zone - IUCN Category II. It is important for foraging areas for migratory seabirds and the endangered loggerhead turtle as well as sharks.

The Oceanic Shoals Commonwealth Marine Reserve multiple use zone is approximately 300 km away from WA-44-L at the closest point. The reserve comprises 71,744 km^2 of Multiple Use Zone - IUCN Category VI. It contains important internesting

areas for turtles for the flatback turtle and olive ridley turtles. It is an important foraging area for the loggerhead turtle and olive ridley turtles.

Mermaid Reef Commonwealth Marine Reserve is ~500 km away from the project area. The Reserve consists of a reef flat 500–800 m wide that shelves into shallow back-reefs rich in corals and a large lagoon up to 20 m deep. It is a key area for over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition (DOE, 2013f).

The seaward boundary of the Kimberley Commonwealth Marine Reserve multiple use zone is ~ 94 km at the closest point to the WA-44-L permit area. The area identified for the reserve is important for foraging of dugongs, dolphins (snubfin, indo-pacific humpback, indo-pacific bottlenose), migratory seabirds, and marine turtles (green, olive ridley and flatback). The reserve area is important for migration pathways for humpback whales, and is adjacent to significant nesting sites for green turtles, and for both foraging and pupping areas for sawfish. All these animals are concentrated close to the Kimberley coast, well away from the WA-44-L permit area. The Kimberley Commonwealth Marine reserve supports or is adjacent to recreational and commercial fishing, tourism activities and areas of Native Title claims and determinations (DOE, 2013e).

Eighty Mile Beach Commonwealth Marine Reserve multiple use zone contains major foraging areas for migratory seabirds, marine turtles, and part of the migratory pathway for humpback whales. It also contains important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish (DOE, 2013k). It is hundreds of kilometres from the permit area.

The Roebuck Commonwealth Marine Reserve multiple use zone includes part of the migratory pathway for humpback whales, foraging areas for flatback turtles, foraging areas for migratory seabirds. It is adjacent to important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish and foraging and calving areas for Australian snubfin, indo-pacific humpback and indo-pacific bottlenose dolphins (DOE, 2013i). It is a hundreds of kilometres from the permit area.

The Montebello Commonwealth Marine Reserve multiple use zone is important for foraging and breeding for migratory seabirds and whale sharks (DOE, 2013j). It contains an important migratory pathway for humpback whales and it contains foraging areas for marine turtles.

State marine protected areas in the outer Browse region include Scott Reef, Browse Island and Adele Island, all of which are state nature reserves.

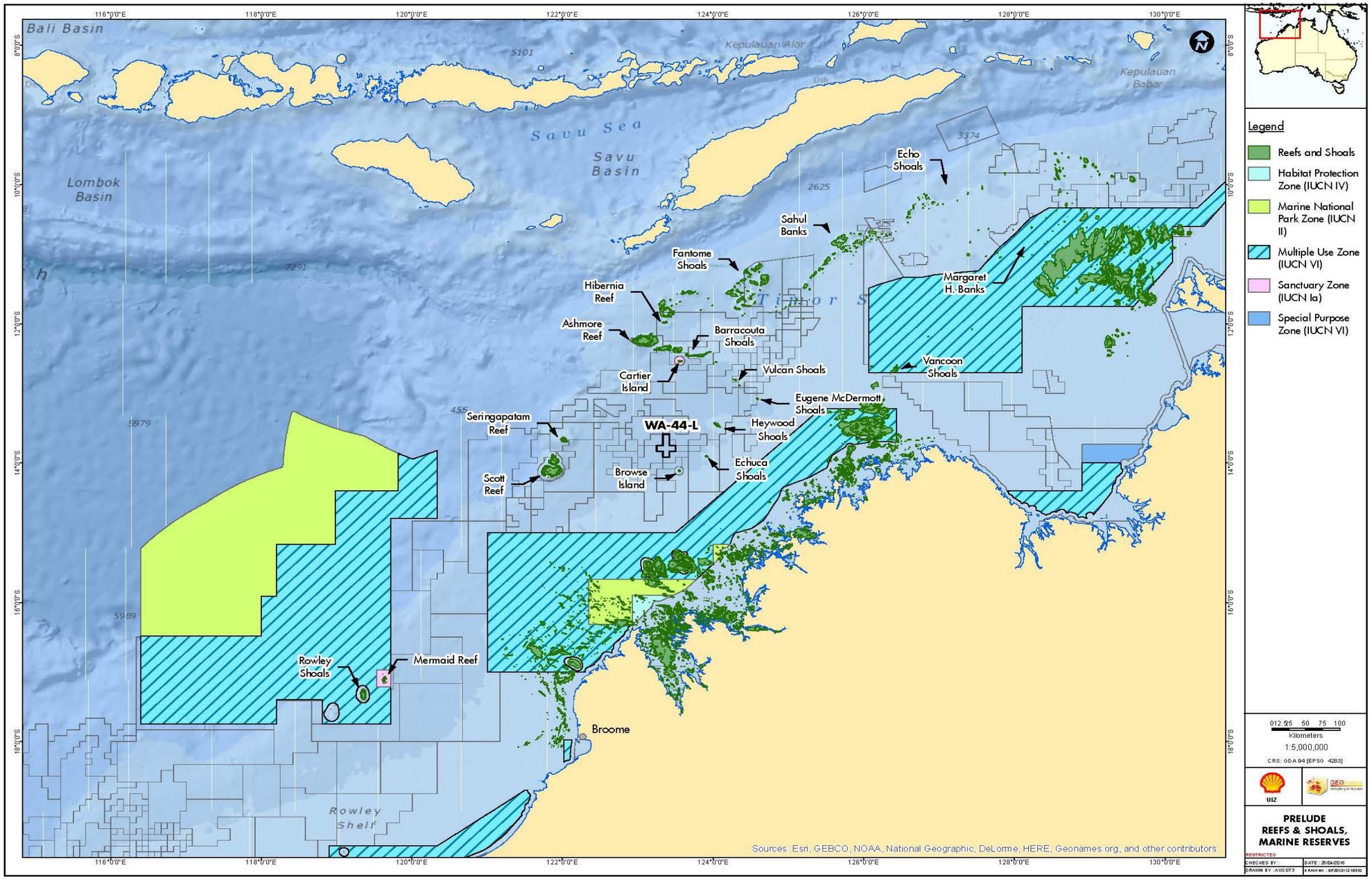

Figure 4: Marine Reserves within the Prelude Zone of Potential Impact

3.5. Socio-Economic Environment

The project area overlaps with a variety of commercial fishing management areas. Commercial fisheries include tuna and tropical finfish, particularly emperor, snapper and cod. Within the northwest region there are also significant commercial fisheries for Spanish mackerel, barramundi, threadfin salmon and shark. WA State managed commercial fisheries permitted to operate within WA-44-L include Mackerel Managed Fishery, North Coast Shark Fishery, Northern Demersal Scalefish Managed Fishery, Pearl Oyster Fishery, and West Coast Deep Sea Crustacean Managed Fishery.

Commonwealth managed commercial fisheries, which are permitted to operate within the Permit area include Southern Blue Fin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, North West Slope Trawl Fishery and Northern Prawn.

Commercial fishing is concentrated mostly in coastal waters and minimum fishing occurs within the vicinity of the permit area.

In 1974, Australia recognised access rights for traditional Indonesian fishers in shared waters to the north of Australia, granting long-term fishing rights in recognition of the long history of traditional Indonesian fishing in the area. A Memorandum of Understanding (MOU) between the Governments of Australia and Indonesia enables Indonesian traditional fishers to continue their customary practices. This area is known as the 'MOU Box' and WA-44-L lies within this area. Given the shallow water target species, these traditional Indonesian fishermen are only likely to be found in deepwater areas during transit to and from the reef locations; therefore, they are unlikely to be affected by the activity.

Currently, there are no known recreational fishing activities in the project area as the site is too far from shore to be accessed by recreational fishermen in small boats. Even at relatively high speed (30km/hour), it would take at least fifteen hours for a recreational boat to reach the project area from the nearest port of Broome.

Oil exploration activities in the Timor Sea commenced in the late 1960s. Since this time numerous wells have been drilled throughout the region. Specifically, petroleum exploration has been active in the Browse Basin since the 1980s, with several commercial discoveries since that time. The Ichthys project in Production Licence Area WA-50-L is immediately to the south of WA-44-L and is the closest known field approximately 20km away but is yet to go into production.

None of the major commercial shipping routes through the Timor Sea passes through WA-44-L. The nearest major shipping lane to the west of the project area is over 200km away. The nearest shipping lane to the north of the project area is approximately 100km. Given the distances between the proposed project area and shipping lanes, the Prelude FLNG activities pose a minimal navigational risk to commercial shipping.

There are no known sites of Aboriginal cultural significance within WA-44-L. Given that the location of WA-44-L is approximately 200km from the mainland, it is unlikely and there are no reports the area is used for hunting or fishing by Australian Aboriginal people. There are no islands or land within the Prelude field and therefore there are no land based Aboriginal heritage sites.

Information on historic shipwrecks is maintained in the National Shipwrecks database, a searchable database of Australian shipwrecks containing shipwreck records provided by the Australian State and Territory governments. A search of the database revealed no known shipwrecks within the permit area.

4. Environmental Impacts, Risk Assessment and Control Measures

4.1. Introduction

The Hazards & Effects Management Process (HEMP) is the process by which Shell identifies and assesses hazards, implements measures to manage them, and demonstrates that risks are reduced to a level that is ALARP (As Low As Reasonably Practicable). This is consistent with the principles outlined in the Australian Standard AS/NZS ISO 31000:2009 Risk Management and HB 203:2006 Environmental Risk Management.

The risks for each planned and unplanned event have been determined using HEMP. The level of risk has been determined by assessing risk likelihood and consequence using the Shell Risk Assessment Matrix (RAM). The RAM is a 6 by 5 matrix that is used for qualitative assessments of Risk and assists determination of appropriate controls and mitigation measures:

- The vertical axis represents increasing Consequences (Severity levels 0 to 5) in terms of potential harm to people, damage to assets, effect on the environment and impact on reputation (PAER categories), with 5 having the greatest severity; and
- The horizontal axis represents increasing Likelihood (levels A to E) of the potential Consequence under consideration, with E having the greatest likelihood.

The Shell RAM sets the level of control required to manage risk as shown in Section 4.1.1

Risk assessment results are shown in Table 4 and discussed further in succeeding sections.

SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Community	Environment	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No effect					
1	Slight injury or health effect	Slight damage	Slight effect	Slight effect					
2	Minor injury or health effect	Minor damage	Minor effect	Minor effect					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate effect					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major effect					
5	More than 3 fatalities	Massive damage	Massive effect	Massive effect					

Figure 5: Shell Risk Assessment Matrix

4.1.1. Demonstration of ALARP

In accordance with Regulation 10A(b) of the OPGGS (E) Regulations, Shell demonstrates that risks are reduced to ALARP where:

The RAM risk is light blue and dark blue:

- Good industry practice or comparable standards have been applied to control the risk based on the hierarchy of control (Figure 6), because any further effort to reduce risk reduction is not reasonably practicable.

The RAM risk is yellow (excluding 5A or 5B):

- Good industry practice is applied.
- All mitigation measures according to the hierarchy of control (Figure 6) are considered. Where these measures are reasonably practicable, they are implemented. This qualitative analysis approach has been used to justify that the risk has been managed to ALARP and is suitable for the risks presented by this activity.

The RAM risk is yellow (5A or 5B) or red:

- Good industry practice is applied.
- The hierarchy of control (Figure 6) is applied.
- Apply a Bow-Tie or equivalent methodology.

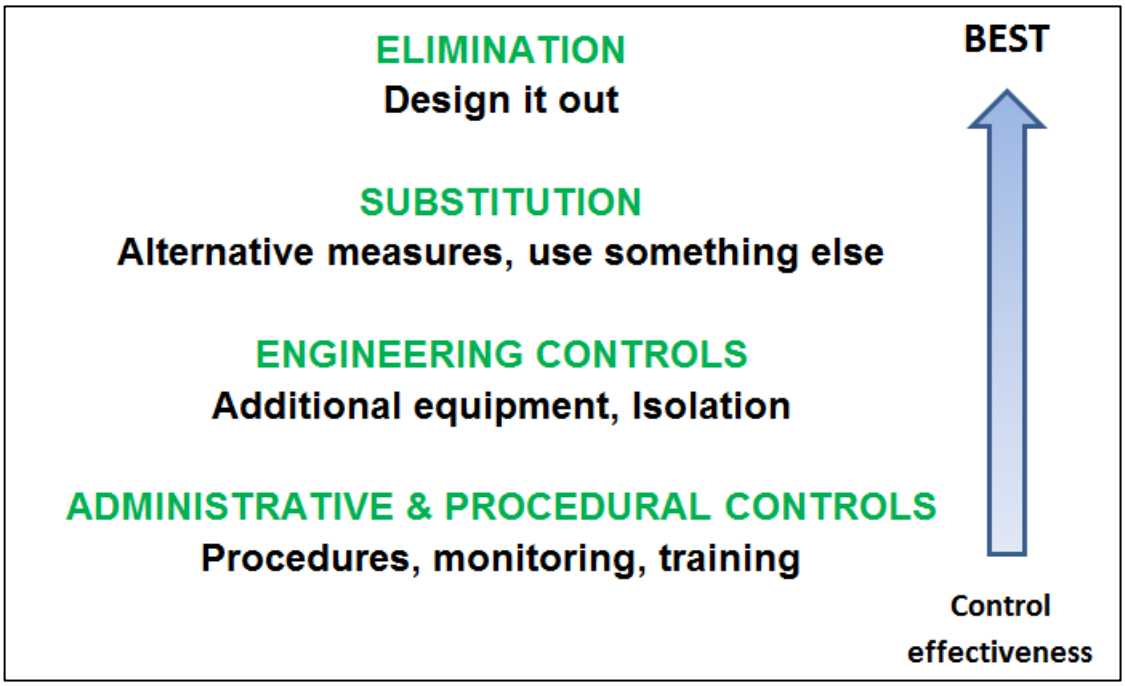

Figure 6: Hierarchy of Controls

4.1.2. Definition of residual risk acceptability

Environmental risks are only deemed acceptable when all reasonably practicable mitigating and management measures have been taken to reduce the potential impacts to ALARP. In accordance with Regulation 10A(c) of the OPGGS (E) Regulations, Shell applies the following process to demonstrate acceptability:

- Light Blue and Dark Blue risks are 'acceptable', if they meet legislative requirements, industry codes and standards, regulator expectations, Shell Standards and/or industry guidelines.
- Yellow and Red risks are ‘acceptable’ if ALARP can be demonstrated, if legislative requirements are met, stakeholder concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. In this acceptability evaluation, the following criteria are accounted for:
    - Principles of Ecological Sustainable Development (ESD) as defined under the EPBC Act;
    - Internal context - the proposed controls and residual risk level are consistent with Shell policies, procedures and standards;
    - External context – consideration of the environment consequence and stakeholder expectations; and
    - Other requirements – the proposed controls and residual risk level are consistent with national and international standards, laws and/or policies.

Table 4: Summary of Environmental Hazards, Potential Effects and Environmental Risks

Hazard / Event	Potential Hazard Consequence	Likelihood of Occurrence	Consequence (Severity)	Risk Level
Physical Presence of FLNG and Vessels				
Physical presence of the FLNG and vessels	Disruption of commercial or recreational fishing or shipping activity.	**C** Frequent encounters with shipping traffic are unlikely as the Prelude field is located distant to major shipping lanes. Fishing effort in area is low and no tourism activities are expected to occur in area due to the distance offshore of the activity.	**1 - Slight effect** May cause small and temporary deviations to shipping routes and or fishing activities. Consequences minimal due to unobstructed open waters and comparably small footprint of the activities.	***Medium (dark blue)***
Lighting of FLNG and vessels	Localised attraction and temporary disorientation of fauna, potentially leading to increased predation or feeding rates.	**B** Extensive modelling of Prelude FLNG facility indicates that lighting is not visible from Browse Island (except when flaring) and that the Prelude activity is not located on major bird or marine fauna migration corridor.	**1 – Slight effect** Activity occurs in remote location and distant from known migratory routes or aggregation areas for birds or marine fauna. The low intensity and seaward location of the flare as seen from Browse Island mean it is unlikely to influence turtle behaviour	***Low (light blue)***
Noise generated by FLNG and vessels	Disruption to behaviour patterns of sensitive marine fauna from vessel operations and/ or movements.	**B** Abundance of noise sensitive fauna at the location is low and any animals in vicinity are likely to move away and not be subject to highest levels of noise.	**2 – Minor effect** Potential effect of behavioural disruptions has no lasting effect and is localised.	***Medium (dark blue)***
Disturbance to seabed	Disturbance to benthic communities as a result of physical disturbance.	**D** Low potential of significant seabed disturbance affecting the seafloor and associated benthic communities.	**1-Slight Effect** Physical impacts are short-lived effects, and temporarily affected areas recover in a short time.	***Medium (dark blue)***
Vessel collision with marine life	Impacts to cetacean or other protected fauna.	**B** Cetacean abundance in the permit area is low and whale interaction requirements should result in whales being observed and avoided.	**2 – Minor effect** Minor impact on overall population in the event of a vessel collision with a marine life.	***Medium (dark blue)***
Introduction on non-native marine species	Introduction of exotic marine species via ballast water	**B** Compliance with Quarantine requirements, low volumes	**1 - Slight effect** Location is in oceanic environment lacking	***Low (light blue)***

Hazard / Event	Potential Hazard Consequence	Likelihood of Occurrence	Consequence (Severity)	Risk Level
via vessels	exchange or biofouling causing alteration to community composition and function, competition with indigenous species.	of ballast (if any) and oceanic environment of location, lacking embayment's for enhanced larval retention times and hard substrates for larval settlement, results in low likelihood of successful introduction of non-native marine species.	environmental sensitivities. The Prelude location is >12Nm from land and deeper than 200m water depth and considered a suitable location for the exchange of high risk ballast according to Australian Ballast Water Management Requirements	
Discharge of drainage waste from the FLNG and vessels	Localised and potential toxic effects caused by contaminants in waste stream.	**C** Low as oil/ water separator treatment prior to discharge, open ocean environment facilitates high dispersion-dilution rates and volumes of oily water low.	**1 – Slight effect** Operations in open ocean well away from sensitivities including Browse Island, any effect short lived and highly localised.	***Medium (dark blue)***
Discharge of sewage and grey water from the FLNG and vessels	Localised and potential toxic effects caused by contaminants in waste stream. (e.g. nutrient enrichment).	**C** Low given prior treatment of sewage and open ocean environment facilitates high dispersion-dilution rates.	**1 – Slight effect** Operations in open ocean well away from sensitivities including Browse Island, any effect is highly localised due to rapid dilution.	***Medium (dark blue)***
Produced Formation Water (PFW)	Localised and potential toxic effects caused by contaminants in waste stream	**B** Low given prior treatment of produced water and open ocean environment facilitates high dispersion-dilution rates.	**2 – Minor effect** Operations in open ocean well away from sensitivities including Browse Island, modelling indicated that all environmental thresholds (of individual components of the PFW) are met within 100-200m of the discharge point.	***Medium (dark blue)***
Cooling Water Discharge	Localised and potential toxic effects caused by slightly warm water and residual chlorine in the discharge	**B** Low given the low concentration of the residual chlorine at the discharge, and open ocean environment facilitates high dispersion-dilution rates.	**2 – Minor effect** Operations in open ocean well away from sensitivities including Browse Island, modelling indicated that suitable dilution is met within 200m of the discharge point.	***Medium (dark blue)***
Discharge of desalination brine	Localised and potential toxic effects caused by saline water in the discharge	**B** Low given the low volume of discharge, and open ocean environment facilitating high dispersion-dilution rates.	**1 – Slight effect** Operations in open ocean well away from sensitivities including Browse Island, modelling indicated increased salinity is expected only at the point of discharge	***Low (light blue)***
Discharge of Chemicals during	Localised and temporary potentially acute toxic effects	**B** Low due to low toxicity of chemicals, open ocean	**1 – Slight effect** Operations in open ocean well away from	***Low (light blue)***

Hazard / Event	Potential Hazard Consequence	Likelihood of Occurrence	Consequence (Severity)	Risk Level
subsea activities	caused by chemicals	environment facilitating high dispersion-dilution rates and low discharge volumes.	sensitivities including Browse Island, any effect short lived and localised.	
Atmospheric Emissions				
Combustion Emissions	Reduction in air quality and increased GHG emissions through combustion of fuel in the energy units of the FLNG and the vessels.	**B** Low given small volumes of emissions and rapid dispersion in offshore atmospheric environment.	**1 – Slight effect** Minor contribution to greenhouse gas and other atmospheric emissions and no local receptors impacted.	***Low (light blue)***
Flaring	Reduction in air quality and increased GHG emissions through combustion of flared gas from the process	**B** Low given small volumes of emissions and rapid dispersion in offshore atmospheric environment.	**1 – Slight effect** Minor contribution to greenhouse gas and other atmospheric emissions and no local receptors impacted.	***Low (light blue)***
Amine treatment off gas venting	Reduction in air quality and increased GHG emissions due to disposal of reservoir gas	**B** Low given rapid dispersion in offshore atmospheric environment.	**1 – Slight effect** Minor contribution to greenhouse gas and moderate contribution to other atmospheric emissions, however no local receptors impacted.	***Low (light blue)***
Fugitive Emissions	Reduction in air quality and increased GHG emissions due to fugitive emissions of gases	**B** Low due to low volumes of emissions and rapid dispersion in offshore atmospheric environment.	**1 – Slight effect** Minor contribution to greenhouse gas and moderate contribution to other atmospheric emissions, however there are no local receptors impacted.	***Low (light blue)***
Total Greenhouse Gas Emissions	Increased GHG emissions	**B** Low due to low volumes of emissions.	**3 - Moderate effect** Long-term contribution to Australia's annual emissions.	***Medium (dark blue)***

Hazard / Event	Potential Hazard Consequence	Likelihood of Occurrence	Consequence (Severity)	Risk Level
Increased GHG emissions during HUC	Increased GHG emissions	**A** Low due to low volumes of emissions.	**3 - Moderate effect** Contribution to GHG emissions.	***Medium (dark blue)***
Waste Management				
Waste management	Localised and temporary potential effects caused by unplanned wastes disposal	**B** Low as no planned waste disposal. Wastes sent to shore for recycling or disposal in government approved waste disposal site.	**1 – Slight effect** Operations in open ocean well away from sensitivities including Browse Island, any effect short lived and localised.	***Low (light blue)***
Emergency Events				
Accidental discharge of hazardous waste or chemicals into the ocean	Potential loss of diesel to the marine environment leading to effects on marine organisms	**B** Low as no discharges of hazardous wastes or chemicals permitted. Wastes sent to shore for recycling or disposal in government approved waste disposal site.	***Spill < 2.5m^3*** **1 – Slight effect** Open oceanic environment with rapid dispersion and dilution.	***Low (light blue)***
		B Low as no discharges of hazardous wastes or chemicals permitted. Wastes sent to shore for recycling or disposal in government approved waste disposal site.	***Spill > 2.5m^3*** **2 – Minor effect** Open oceanic environment with rapid dispersion and dilution.	***Medium (dark blue)***
Fuel spill during bunkering at sea	Potential loss of diesel or fuel oil to the marine environment leading effects on marine organisms.	**C** At sea refuelling conducted in strict compliance with vessel refuelling procedures.	***Spill < 2.5m^3*** **1 – Slight effect** Diesel/ fuel evaporates quickly and will not contact Browse Island.	***Medium (dark blue)***
		C At sea refuelling conducted in strict compliance with vessel refuelling procedure.	***Spill > 2.5m^3*** **2 – Minor effect** Diesel/ aviation fuel evaporates quickly and will not reach Browse Island.	***Medium (dark blue)***
Diesel spill resulting from a collision of vessels	Potential loss of diesel to the marine environment leading to effects on marine organisms.	**B** Low, given installation and support vessel safety and navigational controls, and a 'Notice to Mariners' issued.	**3 – Moderate effect** Diesel/ fuel evaporates quickly with a low probability of contact with Browse Island in the case of a larger spill.	***Medium (dark blue)***

Hazard / Event	Potential Hazard Consequence	Likelihood of Occurrence	Consequence (Severity)	Risk Level
Heavy Fuel Oil spill from product offtake tanker	Potential loss of heavy fuel oil to the marine environment leading to effects on marine organisms.	**B** Low, given low vessel traffic, Prelude safety zones, vessel radar, ARPA, navigation and communication aids	**3 – Moderate effect** Floating oil will not accumulate on submerged features and on open ocean environment with a low probability of contact with Browse Island in the case of a larger spill.	***Medium (dark blue)***
Hydrocarbon Loss of Containment from the FLNG	Potential loss of gas and condensate to the marine environment leading to effects on marine organisms and habitats	**B** Low, given design of offloading arms and hoses.	***Spill <1000m^3*** **3 – Moderate effect** Condensate evaporates quickly with a low probability of contact with Browse Island in the case of a larger spill.	***Medium (dark blue)***
		A Low, given double-hulled design of the FLNG, low vessel traffic, Prelude safety zones, radar, ARPA, navigation and communication aids	***Spill >1000m^3*** **4 – Major effect** Condensate could reach Indonesian boundary, Browse Island and the Reefs, however probability is low.	***Medium (dark blue)***
Hydrocarbon Release from Formation	Potential loss of gas and condensate to the marine environment leading to effects on marine organisms and habitats.	**A** Low due to robust preventative barriers considered as Safety Critical, and rigorous lifting procedure.	**4 – Major effect** Prelude reservoir contains condensate that could reach Browse Island and the Reefs however probability is low	***Medium (dark blue)***

4.2. Physical Presence of Vessels and FLNG

4.2.1. Physical presence

Activity

The physical presence of the Prelude FLNG facility and vessels could potentially affect commercial fishing, tourism, marine protected areas, petroleum activities, commercial shipping and marine environment receptors in the region.

Assessment

The expected impact of Prelude activities on fishing (both commercial and traditional) is expected to be slight to none because of the low fishing presence in the region and the limited available area for fishing due to the safety zone surrounding the facility.

No tourism activities are known to occur in the area due to the water depths and distance offshore. Therefore, impacts to tourism are unlikely.

The nearest marine protected area (Browse Island) is 40km from the site and the presence of the installation and support vessels is not expected to affect Browse Island or the more distant protected areas.

The closest permanent petroleum infrastructure to WA-44-L would be the Ichthys project of Inpex (about 17km south of Prelude). Exploration activities undertaken by other operators are also planned in the region. Prelude activities are not expected to affect these other activities.

Overall, the impact is considered slight and the residual risk of interference with other users is assessed to be medium.

Control Measures

- A 'Notice to Mariners' advising of the presence of the installation vessels will be issued through the Australian Hydrographic Service (AHS) 3 to 4 working weeks prior to the arrival of the FLNG facility on location.
- The Prelude FLNG facility and the vessels are equipped with suitable radar, Automatic Radar Plotting Aid (ARPA), navigation aids and regulatory equipment. Competent crew maintaining 24 hour visual, radio and automatic identification system (AIS).

4.2.2. Lighting

Activity

The FLNG facility and operations require 24-hour external illumination to meet maritime and operational safety standards. The activities during installation and operations are conducted 24 hours a day and require lighting for safety and navigational purposes.

Assessment

Lighting can create light spill, which has the potential to impact both positively and negatively on marine fauna populations for animals that show avoidance or attraction to lights, by potentially changing navigational cues that ultimately affect energy expenditure or altering predation and/or feeding rates.

Since vessels have lower deck height and the line of site distance is shorter than for the FLNG facility the line of sight assessment considers all vessel types.

Table 5 indicates the extent of visibility of the lighting from the FLNG with respect to birds and turtles.

Table 5: Line of Sight Limits for Turtles and Migratory Birds

Light Source	Marine Turtles (limit of light visibility)	Migratory Birds (limit of light visibility)
Flare (when operating)	51km	151km
Topsides (Process Facilities)	27km	127km
Glow from combined luminaries	Effects expected to be minimal given the low levels of particulate matter in the air offshore	

Reference: Prelude FLNG Project Environmental Impact Statement, October 2009.

Turtles

Turtles in nearshore or on the beaches of Browse Island (~40km to the southeast of the porject area) are not able to see the lighting of the FLNG facility. The flare, only when in use, is potentially visible to turtles out to a distance of 51km from the FLNG facility, which encompasses Browse Island.

However, the flare is potentially visible from the northern beaches of Browse Island low on the seaward horizon with intensity similar to a bright star. As the flare is low on the horizon, the Island's landmass blocks light from the flare to the southern beaches so that no beaches on Browse Island are subjected to light from the flare on their landward horizon. Therefore, the landward horizons remain unaltered to nesting and hatchling turtles.

Given the limited amount of flaring that will occur, especially during the operational phase of the project, the distance of the FLNG facility from Browse Island and the unaltered landward horizon at Browse Island, the impacts on turtle hatchlings and adult turtles are considered to be of low magnitude and are assessed to be of minor significance.

Migratory Birds and Seabirds

There are four migratory pathways located within 151km of the FLNG facility but which are only used by a small percentage of the four species of migratory birds. The vast majority of these species populations use other migratory pathways beyond the line of sight of the FLNG facility.

The documented zone of impact for migratory birds that results in a change in natural behaviour is two orders of magnitude smaller than the limit of visibility, at a radius of 5km from an artificial light source. The nearest potential route is approximately 20km from the FLNG facility at its closest point. While uncertain, it is possible that small numbers of migratory birds will be attracted to the lighting of the FLNG facility.

The significance of potential artificial lighting impacts on migratory birds is assessed to be minor.

Other Fauna

Fish and zooplankton may be directly or indirectly attracted to lights. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. This could potentially lead to increased predation rates compared to unlit areas. The intensity of lights may potentially result in a concentration of some marine fauna, although no aggregations were observed during previous drilling activities conducted in WA-371-P since 2006.

The range of attraction for fish and invertebrates to lighting from the FLNG facility is expected to be localised and the magnitude of impacts is considered to be slight.

There is no evidence to suggest that artificial light sources impact on the migratory, feeding or breeding behaviors of cetaceans as they predominantly utilise acoustic

senses to survey their environment, rathen than vision. It is therefore considered that artificial lighting associated with the Prelude FLNG facility is unlikely to impact on cetacean species.

Control Measures

Lighting of the FLNG facility is designed to minimise light spill by:

- Use of low-reflective paints;
- Directing luminaires inwards on the FLNG facility and away from the ocean; and
- Limited flaring during normal operations to reduce impact of light emissions from the flare.

4.2.3. Noise generated

Activity

Noise from Vessels

The main sources of noise from the vessels are typically from engines and machinery.

Vessel noise varies with the size, speed and engine type of the vessel and the activities being undertaken. Smaller, faster vessels typically produce higher-frequency sound at lower source levels than large, relatively slow-moving ships. Support and installation vessels typically produce sound levels around 160-180dB re 1µPa at 1m generally dominated by low frequencies during transit and drop with reduced speed. When vessels are holding station, frequencies increase considerably with the use of thrusters to maintain position, with expected maximum noise levels around 180dB re 1µPa at 1m.

Noise from Prelude FLNG

When the FLNG thrusters are not operating, its underwater noise signature is dominated by the noise produced by the utilities and processing facilities.

The resulting noise levels from the FLNG facility during normal operations are predicted to peak at 50Hz, and the overall source level in the frequency range 10Hz to 2kHz is predicted to be 189.1dB re1µPa at 1m. The highest underwater noise levels produced during the operation of the FLNG facility are expected to occur during operation of thrusters. The requirement to use thrusters is determined by weather conditions and may occur during the berthing and de-berthing of the vessels that will offload the LNG, LPG and condensate, and on occasions throughout the off-loading period.

The alongside offloading configurations for the LNG and LPG carriers may involve the simultaneous operation of thrusters on the FLNG facility, thrusters on the two in-field support vessels (acting as tugs), and the main engines of the berthing tanker. This occurs over an approximate 2-4 hour period during berthing and similarly during de-berthing operations.

The predicted noise levels peak in the frequency range 200 to 400Hz. The corresponding broadband source levels over 10Hz to 2kHz are predicted to be 189.1dB re 1µPa at 1m for the FLNG facility, and 189.7dB re 1 µPa at 1m for the combined effect of two tugs. If all sources are co-located, their combined source level is predicted to be 192.4dB re 1µPa at 1m.

Assessment

The effects of sound on organisms have mostly been studied in cetaceans, with less known about the effects of sound on other groups of animals. There are a number of species of whale that may travel through the region.

The use of sound in the underwater environment is important for marine animals, particularly cetaceans, to navigate, communicate and forage effectively. Underwater noise may impact on marine organisms in the following ways:

- disturbance, leading to behavioural changes or displacement from areas;
- masking or interference with other biologically important sounds such as communication or echolocation (used by certain cetaceans for location of prey and other objects);
- physical injury to hearing or other organs; and
- indirectly, by inducing behavioural and physiological changes in predator or prey species.

Marine Mammals

The extent of the impacts of underwater noise on marine animals depends upon the frequency range and intensity of the noise produced, and upon the hearing, vocalisation and other biological characteristics of the organism affected.

A report by Southall et al (2007) has summarised observed marine mammal response to anthropogenic noise according to category of marine mammal and type of noise. For low frequency hearing marine cetaceans (baleen whales such as blue, humpback and minke whales), limited or no response has generally been observed for anthropogenic sound levels of 90-120dB re 1µPa. Increasing probability of avoidance and other behavioural effects have been reported for sound levels in the 120–160dB re 1µPa range. No extreme behavioural responses have been reported. For mid frequency hearing cetaceans (toothed whales such as sperm whales and bottlenose dolphins), limited or no response has generally been observed for anthropogenic sound levels below 130dB re 1µPa.

Based on these findings, it can be inferred that above 150dB re 1µPa, there are increasing probability of responses to FLNG facility noise, while below 130dB re 1µPa, there are no to minor response for both baleen and toothed whales.

Noise modelling for the Prelude FLNG facility indicates that the 150dB re 1µPa level corresponds to a maximum distance of about 200m from the facility during berthing / deberthing activities and about 50m during normal operation of the FLNG facility.

The 130dB re 1µPa level corresponds to a maximum distance of about 3.7km during offtake activities and about 600m during normal operation of the FLNG facility.

Richardson et al. (1995) also report that 50% of migrating grey whales avoided drilling rigs when sounds exceeded 117dB re 1µPa, which, according to modelling, corresponds to a distance of about 1.3km during normal operation and 9km during offtake activities from the Prelude project area. The risk of significantly impacting individual whales or a population is very low.

Therefore, noise from the Prelude FLNG activities will not be detected by the overwhelming majority of migrating humpback whales located some 200km away. The small number of whales occurring in deeper waters, closer to the Prelude FLNG location, may show behavioural responses if they approach within a few kilometers. However, given the open ocean environment with no geomorphic restrictions on whale

migration, whales are expected to swim past the vessels at a distance they are comfortable.

Turtles

There is little information available in relation to noise impacts on turtles. Turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range 100 – 700Hz.

Six species of protected marine turtles may occur in the vicinity of the Prelude field, with green turtles known to nest on Browse Island (approximately 40km from the proposed FLNG facility location). For most inter-nesting periods, female green turtles stay within 5km up to 18km of nesting beaches). Given the distance to Browse Island including the inter-nesting area and deep water at the Prelude location, the area is not expected to support significant numbers of turtles and it is unlikely that the noise produced by FLNG facility activities would cause disruption to normal breeding behaviour. Impacts on inter-nesting green turtles would be behavioural at worst which may cause a slight consequence as the sound levels they would be exposed too would be for offtake periods only at approximately 100-110 dB re 1µPa (rms).

Fish and Sharks

Fish have been shown to respond to high levels of man-made noise by changing schooling behaviour, moving away from the source of noise or in extreme situations, by becoming stunned and disoriented. Surface and mid water dwelling fishes may be initially affected by vessel movements and normal production noise. However, the accumulation of fish adjacent to operating facilities indicates that in the absence of any associated threats, they can be expected to habituate to this noise.

Sound intensities from Prelude activities are unlikely to reach a level that would result in physical damage to fish.

Overall, the consequence of disruption to behaviour patterns to marine fauna is assessed as minor and the residual risk level is considered medium.

Noise Control Measures

- The design of the FLNG facility is such that the majority of the process equipment is mounted on the topsides of the FLNG facility, not in the hull and certain topsides modules are mounted on elastomeric mounts to reduce vibration; the FLNG facility is designed to meet occupational health and safety noise limits, which also limits environmental noise impacts.
- A maintenance program has been developed for the FLNG facility and supply vessels that include corrective maintenance of noise suppression equipment.

4.2.4. Disturbance to Seabed

Activity

During installation activities localised seabed disturbance occurs with a low potential of significant seabed disturbance. The disturbance results from lifting of pre-laid mooring lines and flowlines and hooking up to the FLNG facility.

The total area directly affected by the Prelude FLNG facility and subsea facilities footprint is approximately 11,000m^2.

Assessment

Installation of subsea facilities has physical impact on the seafloor and the associated benthic communities. The significance of the impact depends on the sensitivity of the seafloor habitat being affected.

The seabed at the Prelude FLNG location has little evidence of epibenthic communities due to the low variance of sea floor topography and absence of hard substrates, which limits the habitat for epibenthic organisms. This has been determined for the Prelude location from side scan sonar, a 3D seismic survey and geotechnical data collected across the permit area.

The soft seabed comprised of very soft siliceous carbonate silts, has been shown to support a high diversity but low abundance community of infaunal and epifaunal animals. The likely impacts to the benthic communities include smothering and temporary disturbance but soft sedimentary communities have been shown to respond rapidly to disturbance and impacts are thus expected to be slight and short lived.

The permanent subsea structures provide substrate for encrusting fauna and flora that would not otherwise be successful in colonising the area. Where colonisation is permitted to occur, fish and other organisms may be attracted as a food chain develops. The structures may also attract fish by providing protection and habitat not otherwise available. For those fish species preferring some structural habitat complexity, the presence of seabed structures is likely to have a beneficial impact. The environmental impacts associated with the provision of artificial habitat are locally increased biological productivity and diversity.

Given the widespread extent of similar habitat, the low sensitivity of the Prelude location, and the high likelihood that temporarily affected areas recover in a short time, the environmental effects are considered to be of minimal ecological significance, thus the overall impact is considered slight and the residual risk level medium.

Control Measures

- The facilities are laid according to plan;
- As-laid surveys are performed to confirm the facilities have been laid as per the planned locations.

4.2.5. Vessel collision with marine life

Activity

While the presence of whales and dolphins (cetaceans) at location in WA-44-L is shown to be low, the potential collision risk with installation vessels and the vessel traffic to/from the project location has been considered. The risk is low because support vessels are displacement vessels with only moderate cruising speeds, typically less than 15 knots.

Assessment

WA-44-L is not nearby to known cetacean feeding or breeding areas and is distant to the humpback whale migration routes; therefore, the abundance of cetaceans in the area is not expected to be high. Animals are expected to alter course away from the stationary or slow-moving installation and support vessels. The support vessels are transporting supplies between Darwin or Broome and the installation vessels through coastal waters where the abundance of cetaceans is likely to be higher. However, the cruising speed of support vessels is relatively low and the support vessels during transit maintain a watch and alter course for cetaceans in line with the requirements of Part 8 of the EPBC Regulations 2000, Australian National Guidelines for Whale and Dolphin Watching (Commonwealth Government of Australia 2005), and therefore the risk is considered acceptable.

This activity is identical to vessel movements from other ports along the Western Australian coast where the incidence of vessel strike is low. The impact on overall

populations of cetaceans from injury from a collision is considered minor and the residual risk of this occurring is considered medium.

Control Measures

All vessels during transit adhere to the requirements below based on the EPBC Regulations Part 8, Australian National Guidelines for Whale and Dolphin Watching (Commonwealth Government of Australia 2005) and industry experience, specifically:

- Vessel Masters[1] shall maintain a watch for whales during transit.
- Vessel Master shall not knowingly approach within 300m of whales or 50m of dolphins.
- If whales are observed within 300-100m of vessel during transit, Vessel Master maintains or reduces speed and alters course away from the whales if safe to do so.
- If whales are observed <100m from vessel, Vessel Master powers down to 'no wake speed' (< 4 knots) and alters course away from the whales if safe to do so.

4.2.6. Introduction of non-native marine species from vessels and facility

Activity

The three primary mechanisms with the potential to cause inadvertent introduction and spread of unwanted species are hull fouling, ballast water discharges and aquaculture activities. The overwhelming majority of these introductions are confined to coastal waters with a significantly greater occurrence in temperate waters than the tropical waters of Prelude location.

The majority of the vessels that will be used for installation activities will originate from overseas ports. The expectation is for the main vessels to go directly to the Prelude field without the need for entering any Australian port or coastal waters. All vessels with an overseas 'last port of call' will obtain all required biosecurity clearances prior to entering Australian waters.

For Prelude FLNG, a Biofouling Management Plan will be developed to address the risk of bringing in invasive marine species from the shipyard in Geoje, South Korea to Australia. This will include biofouling removal to as low as reasonably practicable and in compliance with the Biosecurity Act 2015. Before reaching Australian waters, ballast water exchange takes place in open water, that is, at sea with clean open ocean water, typically 200 nautical miles from the nearest land and in water depths >200m deep as per the IMO guidelines (International Convention for the Control and Management of Ship's Ballast Water and Sediments 2004). This recognises that coastal species found in ports and coastal waters (those associated with ballast water from Geoje) are unlikely to survive in open ocean environments.

Once on site and operational, the FLNG facility takes up and discharges ballast water regularly as it produces cargoes and exports the products to off take tankers but this ballast poses no threat as the FLNG facility is permanently moored and does not travel to or from other ports.

Ballast water requirements for the installation vessels, tug boats and support vessels are limited. All vessels engaged by Shell are obliged to conduct ballast tank operations in line with IMO guidelines and, where applicable, comply with Biosecurity Act 2015. Ballast water exchange must also be done in open waters. This is particularly important

[1] Vessel Master or deputy on duty on the vessel bridge

for vessels coming from outside of Australia so as not to “contaminate” the Prelude area.

Assessment

The Prelude FLNG facility is cleaned to as low as reasonably practicable (to bring Prelude FLNG to low risk) prior to arrival in Australian water. Ballast water exchange for the FLNG facility and associated vessels is done in accordance to IMO Guidelines (International Convention for the Control and Management of Ship’s Ballast Water and Sediments 2004) and the Australian Ballast Water Management Requirements.

For the vessel that regularly travels from the onshore logistics base to the FLNG, discharge of ballast water in the Prelude area is expected to be limited. Support vessels carry comparatively little ballast water for trimming purposes compared to other merchant ships.

Potential marine pests listed by Australian agencies are known to inhabit harbours, embayments, estuaries, shorelines and/or shallow coastal waters less than 200m deep (Hayes et al. 2004, Barry et al. 2006). The water depth at the Prelude FLNG location is in excess of 200m.

Therefore, the deep water and open ocean environment in Prelude provides minimal larval retention times or suitable habitat for coastal adapted exotic species. Hence, the likelihood of the introduction of exotic or introduced marine species is remote. Therefore, the impact of potentially introducing exotic marine species into an open ocean environment at the Prelude FLNG location is considered slight and the residual risk low.

Control Measures

- All vessels and the FLNG facility will comply with the requirements of the Biosecurity Act 2015.
- No ballast water (originating from outside Australian waters) exchange will occur within the safety zone of the FLNG facility. The product carriers and other international vessels will exchange their ballast deep sea before arriving at the Prelude, therefore, they will discharge only low risk ballast water at the facility.
- Prelude biosecurity management involves Department of Fisheries (DoF) and Department of Agriculture and Water Resources (DAWR) input on requirements. This includes requirements on Australian biosecurity management for the FLNG facility, and other vessels and domestic conveyances supporting the Prelude project. The objective is to demonstrate how Shell Australia will manage the movement of the FLNG facility and conveyances and cargo to minimise the likelihood of biosecurity risk material being introduced into, or transported around, Australian territory. Biosecurity management will address the following:
    - Biofouling management in accordance to the IMO Guidelines for the Control and Management of Ships Biofouling to Minimise the Transfer of Invasive Aquatic Species;
    - Biofouling removal from the Prelude FLNG facility will be done in accordance with requirements prior to sail-away on an ALARP basis;
    - The Prelude FLNG facility will do a ballast water exchange before entering Australia Exclusive Economic Zone;
    - An ‘Approved Arrangement’ may be applied for Prelude FLNG. To achieve this, the FLNG facility must be considered low risk with respect to biosecurity;

- If required, the 'Approved Arrangement' of the FLNG facility will allow support vessels and other conveyances to go to and from Australian ports without coming under biosecurity control and associated clearance every trip back to shore (will be considered as 'domestic status');
- Vessel movements will be managed such that they have low/acceptable risk rating prior to entry to Australian territory and state waters;
- Reporting requirements in case of suspected detections of marine pest in state waters; and
- All of the above will be done in accordance to the Biosecurity Act 2015 and regulations.

4.3. Liquid Discharges

4.3.1. Discharge of drainage wastes

Activity

Vessels

Deck drainage from vessels consists mainly of wash down water, seawater spray and rainwater and may contain small quantities of oil, grease and biodegradable detergents present on the deck, which has the potential to create surface sheens and short term, localised reduction in water quality if it enters the marine environment.

Prelude FLNG

Runoff from areas containing LNG, Mixed Refrigerant (MR) or LPG processing or storage is immediately discharged overboard to ensure that cryogenic spills are not left in situ to develop into flammable gas clouds on the facility, but rather are moved directly outside of the Facility boundaries. This is a design safety measure. In the unlikely event of a spill, the liquefied hydrocarbons would change phase (i.e. vaporise from liquid to gas) rapidly with minimal effect on the marine environment. Therefore, in areas where potential cryogenic spills can occur, storm-water, sea spray and water generated from routine operations such as deck and equipment cleaning and fire drills are not collected and contained. These streams are normally entirely oil free.

To prevent potential spills during maintenance of hydrocarbon containing equipment in cryogenic areas, temporary containment are provided during the maintenance activities.

For storm-water, sea spray and water generated from routine operations coming from process or other areas where oil is potentially present, drainage is directed to an oil-water separation system.

The FLNG facility also has a machinery space and thrusters where run-off is collected in a bilge sump and treated prior to discharge to meet MARPOL limits of 15ppm oil in water.

Assessment

The closed drain system will not have any liquids discharged to the ocean; therefore there are no risks or impacts associated with the closed drains systems.

There may be small amounts of chemical wastes that are not captured in the treatment systems associated with the open drainage system. These minor quantities will be diluted before discharge and there is potential for the following receptors to be impacted: cetaceans, turtles, fish, birds, benthic fauna and plankton.

With the exception of seabirds, all of the above receptors rely on marine water as habitat. Liquid wastes have the potential to affect the physical, chemical and biological marine environment, which could pose a threat to the identified receptors. However, no adverse ecological effects are anticipated because of the low concentration of contaminants, the lack of nearby sensitive habitats, low abundance of receptors in the project area and rapid dilution rates in an open ocean environment.

Overall, the impact of the discharge of liquid waste to the environment is considered slight and the residual risk medium.

Control Measures

- Vessels are certified for their class and have MARPOL 73/78 compliant oil-water systems such that discharge from vessels is not greater than 15ppm dispersed oil and vessels have appropriate Shipboard Oil Pollution Emergency Plans (SOPEP);
- The FLNG facility's drainage system is such that areas with liquid hydrocarbons are directed to an open drain or closed drain system connected to the MARPOL system and oil/water separator system, designed to meet the MARPOL requirements (MARPOL 73/78 Annex I – Regulation for the Prevention of Pollution by Oil from Ships;
- Discharge to sea from the FLNG facility MARPOL slop tanks is monitored by Oil discharge monitoring equipment. A sampling point is also available for periodic testing of oil content (and other potential contaminants) by laboratory test. The system also has the ability to automatically stop the discharge when the 15ppm limit of oil is exceeded;
- Designated storage areas for oil products, which are contained to prevent discharge of oil to the sea;
- Designated containment zones for area which are potential sources of oily discharges;
- Chemical selection ensures that chemicals which are discharged to the ocean will have the least potential impact to the environment; and
- FLNG induction to educate FLNG personnel on correct use of drains system.

4.3.2. Discharge of food wastes, sewage and grey water

Activity

Vessels

The expected number of crew members and domestic sewage discharge for each vessel is as follows:

Table 6: Typical POB and sewage volume of installation vessels.

Vessel	Typical POB	Estimated sewage volume (m^3/day)
Deep Orient/ Installation vessel	120	25
Accommodation Support Vessel	500 to 650	120
Supply Vessels	65	50
Infield Support Vessels (ISV)	9	5

All discharges from the installation and support vessels comply, as a minimum, with the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, which enacts MARPOL 73/78 requirements.

Prelude FLNG Facility Operations

The FLNG Facility will normally have 110 – 150 personnel on Board (POB) but can accommodate up to 340 POB when required for maintenance turnarounds or during commissioning.

The sewage treatment plants on the FLNG facility are designed to meet MARPOL Annex IV and IMO Resolution MEPC159(55) standards for effluent discharge.

The sewage system consists of two sub-systems:

- Black Water
- Grey Water

The black water system processes raw sewage from the toilet bowls in the accommodation, hospital, forward machinery space and aft machinery space. The treatment process uses activated sludge technology coupled with final stage chemical disinfection. The final stage effluent, when discharged overboard, does not present a pollution hazard to the marine or coastal environment.

The grey water system processes the effluent stream from sinks, washbasins, showers, laundry and sweat drains.

The expected combined flow rate of sewage and greywater is 70m^3/day during commissioning/turnarounds and 30m^3/day during normal operation.

Assessment

There are no nearby sensitive habitats likely to be impacted by the small increase in nutrients from these wastes. Modelling of sewage and greywater show that TSS, coliforms, oil/grease, and similar constituents modelled as a non-decaying “numerical dye” dilute rapidly upon discharge, and will meet UNEP (1999) standards within 70m of their discharge. Other discharged compounds will dilute quickly, limiting potential impacts.

Given waste treatment, small quantities involved, the chemical properties of the discharged materials which are highly biodegradable and low persistence, the rapid dilution in the open ocean environment, localised impact area, and significant distance from coastlines (~40km away), any impact is slight and the risk medium.

Overall the impact of discharge to the surrounding environment is considered slight and the risk is considered medium.

Control Measures

- All discharges of food wastes and sewage from vessels will comply with the Protection of the Sea (prevention of Pollution from Ships) Act 1983, in particular AMSA Marine Order 96 (MARPOL 73/78 Annex IV: Sewage) and AMSA Marine order 95 (MARPOL 73/78 Annex V: Garbage). All the vessels are designed to be able to operate within 3NM of land under the MARPOL 73/78 requirements;
- For the FLNG facility, the designed treatment of the sanitary wastewater is in accordance with MARPOL 73/78 requirements (AMSA Order 96). Sampling point is provided on the treated sewage discharge line to perform the lab analyses to regularly monitor compliance of the discharge to the standards;
- Food wastes are macerated to pass through a screen of less than 25mm diameter prior to discharge, in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 [Section 26F(7)] i.e. > 3 Nm from land (AMSA Marine Order 95).

4.3.3. Produced Formation Water (PFW)

Activity

Produced formation water (PFW) is water which has permeated into the gas reservoir over time. When the liquid and gaseous hydrocarbons are extracted from the reservoir the produced formation water is also removed and is separated from the products in the inlet facilities. Process water, including condensate water, is similar to produced formation water in that it is an unrequired by-product of the gas extraction process.

The Produced Water Treatment System of the Prelude FLNG facility is designed for 165m^3/hr discharge capacity. Hydrocarbons from the produced and process water are extracted by the Macro Porous Polymer Extraction (MPPE) Package. The package is designed to remove hydrocarbons in the water stream to 30ppm. A buffer tank is available to recycle and retreat PFW if it is offspec. Only treated water from MPPE package is routed overboard to sea. The predicted constituents of the discharged treated PFW are summarised in Table 7.

Table 7: Predicted Concentration of PFW Constituents

Constituent	Predicted Concentration of constituent at discharge (mg/L)
TPH	30
Dispersed oil	6
Benzene	18
Toluene	0.681
Ethyl Benzene	0.151
Xylene	1.57
NPD (naphthalene, phenanthrene and di-benzothiophene)	0.107
Other PAHs	0.004
Phenol	0.757
Alkylphenols	2.73
Arsenic (III/V)	<0.005
Cadmium	<0.005
Chromium (III/VI)	0.027
Copper	0.01
Lead	<0.005
Nickel	0.011
Zinc	0.032
Iron	71
Barium	2.3
Hydrogen Sulfide (Sulfide ion)	NA
Ammonia	NA
NORM (total isotope) *	NA
Silver	NA
Vanadium	NA
Mercury	0.0024
Process Chemical - Active Constituents	NA
Strontium	38
MEG	1000

NA: Information not currently available. However, information will be gathered and monitored during operations.

Assessment

Considering that PFW is first treated before discharge, Shell has taken a further conservative approach to assessing the potential impacts of discharging the treated

PFW. This approach assumes potential impacts to water and sediment out to 2,000 m from the FLNG facility which is accepted to be the maximum distance for impact from produced water discharges from offshore platforms. This conservative approach takes account of the specifications of the PFW discharge.

Modelling results for the PFW discharge from the Prelude FLNG facility indicate the PFW discharge plume would be diluted approximately 100-fold by the time it has travelled 50m from the discharge location, and over 400-fold by the time it has travelled 250m. This means that suitable dilution of all individual constituents of the PFW is predicted at 250m from the FLNG facility at all times on the basis of the ANZECC Water Quality Guidelines thresholds. Key individual constituents included in the modelling study include alkylphenols, polyaromatic hydrocarbons (PAH), chromuim and iron.

Table 8: Percentage of time that PFW thresholds are predicted to be reached

Constituent	Percentage of time thresholds are met within 50m of discharge	Percentage of time thresholds are met within 100m of discharge
Alkylphenols	95%*	>99%*
PAH	95%	>99%*
Chromium (III/VI)	95%	100%
Iron	95%	100%
All other contaminants**	100%	100%

* value for chronic oestrogenic effects

**Unknown for those contaminants not assessed in modelling (NA).

Extrapolating the modelling results, it is reasonable to expect at least 10,000 dilutions within 2,000m of the source, 100% of the time. Therefore, beyond 2,000 m, there are predicted to be no impact from the PFW discharge as this is a common limit observed from oil and gas facilities. Given the receiving environment (water column and soft benthic habitat with a low density of benthic organisms) surrounding the FLNG facility is the same between 200 – 2,000 m from the facility and well represented within the region, the impacts to this area (200 – 2,000 m) is not significant in a local or regional context.

Therefore, the impact of the discharge of PFW to the environment is considered minor.

Control Measures

- Best Available Technology chosen for the PFW treatment system, which removes both dispersed and dissolved hydrocarbons from the waste stream;
- High availability of the MPPE system (by designing in redundancy);
- The total oil content of the produced water discharge is not to exceed 30mg/l averaged over any 24-hour period, except during well clean-up and well fluids commissioning. Alarms and automatic switch-off of discharge to ensure water specifications are met before discharging;
- Online analyser for the Oil-in-Water is provided on the discharge point to ensure discharge limits are achieved. If the online analyser is down, manual sampling and analysis will be done;
- Full chemical characterisation and whole effluent toxicity testing of the produced water discharge to further understand and validate the impacts of the discharge.
- In-field sampling and monitoring to validate predicted impacts;

- Chemical management system to ensure that chemicals are chosen based on ALARP principle. Dosing of chemicals within the process system are minimised to the required level; and
- An adaptive management to aid in understanding and managing the impacts of the produced water discharge particularly if there are changes in the process or operations.

4.3.4. Cooling Water Discharge

Activity

Seawater is used as a heat exchange medium for the cooling of machinery engines and in the production process. Seawater is drawn from the ocean and flows counter current through closed circuit heat exchangers, transferring heat from the machinery or production process to the seawater via an intermediate circulating freshwater system. It is then discharged to the ocean around 5°C to 14°C above the ambient seawater temperature (depending on season).

Chlorine in the form of sodium hypochlorite is added to the cooling water to minimise the potential for any marine growth within the pipework of the cooling water system. As such there is residual hypochlorite concentration of maximum 0.2ppm at the point of cooling water discharge during continuous dosing. This is in line with the World Bank Guidelines requirement for residual chlorine in cooling water discharge of 0.2ppm.

The Prelude FLNG facility has 12 cooling water discharges that are situated below the water line towards the stern of the facility. They differ by flow rate, pipe diameter and orientation.

Assessment

The effect of chlorine and chlorine breakdown products in cooling water discharges has been the subject of many studies, generally through toxicity testing.

Residual chlorine modelling results show that the threshold limits for chlorine are exceeded only 10% of the time at 50m distance from the various outfalls, and a suitable dilution expected at all times at 200 meters.

Thermal dispersion studies indicate that the maximum increase in background sea surface temperature in the vicinity of the FLNG facility, as a result of previous cooling water discharges, will be 0.4°C. This occurs when tidal flows are low during summer. During winter, the temperature difference between the discharged cooling water and ocean is less so this temperature effect is reduced.

Given the localised temperature changes compared to the size of the receiving environment and the low concentrations of chlorine and chlorine by products, the magnitude of impact from the discharge of cooling water is small and impacts are unlikely, the significance of impact is therefore assessed to be minor.

Control Measures

- Chemical dosing is automatically controlled to minimise residual chlorine at discharge;
- Online monitoring of temperature, residual chlorine and flow of the discharge to ensure that residual chlorine and temperature limits are met.

4.3.5. Discharge of desalination brine

Activity

The production of fresh water from seawater in the freshwater generators of vessels and the FLNG facility can potentially result in a discharge of seawater with a slightly elevated salinity (around 10% higher than seawater). The volume of the discharge is dependent on the requirement for fresh (or potable) water. Standard requirements for freshwater for the FLNG facility will be approximately 70 tonnes/hr, however this figure may be up to 50% higher during commissioning and maintenance activities, which require a greater number of people to be located at the facility for short periods of time.

Assessment

Desalination brine discharge is estimated to be about 32 tonnes/hr. Being of greater density than seawater, this will sink and disperse in the currents. The largest increase of salinity experienced would be approximately 10% in the immediate vicinity of the discharge point. Most marine species are able to tolerate short-term fluctuations in the order of 20% to 30%, and it is expected that most pelagic species passing through the project area would tolerate short-term exposure to the slight increase in salinity caused by the discharged brine.

The biocide and anti-scale chemicals used have low inherent toxicity suitable for use in potable water systems. Environmental impacts as a result of the discharge of desalination brine to sea are therefore rated as unlikely to occur and to be of low magnitude. As such, the impact significance is assessed to be slight.

Control Measures

- Chemical dosing controlled to minimise chemicals at discharge.
- Online monitoring of flow and temperature.

4.3.6. Discharge of hydrocarbons and chemicals during subsea activities

Activity

The Prelude subsea facilities are designed to limit the potential for discharge of mono-ethylene glycol (MEG), freshwater, storage fluids and chemicals to the ocean. Where discharges may occur, these are for short periods and in low volumes during the installation and commissioning activities, as well as during subsea intervention works. This is standard industry practice and complies with industry regulations.

Prior to installation and commissioning, all subcomponents have been strength tested and leak-tested. Hydraulic lines and subsea equipment are pre-filled with fluids. During make-and-break of subsea connections during installation and intervention works and the use of ROV, some disbursement of liquids occur.

Subsea facilities commissioning will result only in incidental releases especially during tie-ins.

Subsea control fluids are used to open or close wellhead valves. These systems are typically open-loop systems with small volumes of subsea control fluids discharged each time a valve is operated.

The majority of the maintenance/intervention activities are non-intrusive visual inspections done by a ROV as the facilities are designed for 25 years field life. Other potential discharge during subsea intervention activities is hydraulic oil from the ROV.

During light well intervention activities, MEG, freshwater and associated chemicals similar to those described further below are potentially discharged from the Prelude production trees and well intervention tooling.

All chemicals that are planned to be discharged are assessed using the chemical selection process.

Assessment

The guiding principle for the selection of fluids is to select the solution with the most acceptable environmental footprint that meets technical requirements. The likelihood of discharge causing toxic effects is low due to low volumes and selection of chemicals of low toxicity. The open ocean environment and low volumes of discharge facilitate high dispersion-dilution rates. Therefore, the overall resulting impacts are considered minor with no long term effects anticipated.

Control Measures

- The subsea facilities are designed to minimise release of fluids to the environment;
- Chemical management system to minimise the risk of those chemicals which are used within the subsea systems;
- During installation and commissioning, majority of the preservation and commissioning fluids are collected onboard the FLNG facility for re-processing or sent to shore for treatment and disposal.

4.4. Atmospheric Emissions

4.4.1. Combustion Emissions

Activity

The main source of combustion atmospheric emissions from the Prelude FLNG project is the combustion of liquid fuel in the energy units (e.g. generators, pumps, etc.) of the vessels, and the combustion of fuel gas for steam generation in the FLNG facility.

The estimated rate of fuel use and associated emissions for some of the project's main vessels are provided below:

Table 9: Fuel Consumption Rate and Emissions of Installation Vessels.

Vessel	Typical Fuel Consumption Rate (m^3/day MGO)			Fuel Consumption Emissions
	Standby/ Alongside	On DP	In transit	
Deep Orient/ Installation vessel	7	13 (2 Gen.)* 19 (4 Gen.)*	17 (2 Gen.)* 23 (3 Gen.)* 32 (4 Gen.)*	CO_2 ~ 2700kg/m^3 SOx ~ 0.5% m/m S content NOx ~ 9.4g/kWhr
ASV	16	22	50	CO_2 ~ 2700kg/m^3 SOx ~ 0.5% m/m S content NOx ~ 9.4g/kWhr
Supply Vessel	2.0		8.5	CO_2 ~ 2700kg/m^3 SOx ~ 0.1% m/m S content NOx ~ 9.4g/kWhr
In-field Support Vessel	2.8		10.8	CO_2 ~ 2700kg/m^3 SOx ~ 0.1% m/m S content NOx ~ 9.4g/kWhr

*Number of Generators Active
MGO = Marine Gas Oil

The main steam supply for the Prelude FLNG facility is from 7 x 200MW boilers. These boilers produce steam for use as a heat source, to turn steam turbines for power generation (3 x 40MW) and for driving the refrigerant compressors and other main rotating equipment. The boilers are dual-fuel and during start of commissioning, the boilers will run on diesel. In addition to the Main Power Supply, the FLNG facility

includes Essential Power Generators, which run on diesel. The Essential Power System is included in order to provide power for:

- Black Start operations;
- Bringing the process to a safe condition during any major power upsets; and
- Essential power consumers in case of a complete plant shutdown.

Power supply from the Essential Generators is 3 x 7.7MW marine generators.

Emergency power generators are also provided as further back up for emergency uses.

The expected emissions from these sources are shown in Table 10.

Table 10: Expected Gaseous Emissions from Combustion Sources of the FLNG

System	Flowrate of Discharge	Composition of Discharge
HP steam boilers (6+1) (running with Fuel gas)	1 360 000kg/h	N_2 – 71.40 %wt H_2O – 10.86 %wt O_2 – 2.17 %wt CO_2 – 14.46 %wt NOx – 240mg/Nm^3 SOx – NA PM – 50mg/Nm^3
HP steam boilers (for one boiler running with marine diesel at 100% load)	266 000kg/h	N_2 – 73.20 %wt H_2O – 5.5 %wt CO_2 – 19.14 %wt O_2 – 1.95 %wt NOx – 400mg/Nm^3 SO_2 – 1500mg/Nm^3 PM – 50mg/Nm^3
3 Essential generators (3 x 7.7MW)	168 000kg/h	CO_2 – 8.24 %wt CH_4 – 5.67E-04 %wt N_2O – 7.68E-05 %wt CO – 4.71E-02 %wt NOx – 2.14E-01 %wt SOx – 1.05E-01 %wt PM – 6.14E-03 %wt TVOC – 5.43E-03 %wt
1250kW Emergency diesel generator	9010kg/h	NOx – 0.21 % wt CO_2 – 8.00 %wt CO – 0.05 %wt SO_2 – 0.10 %wt PM10 – 0.01 %wt
750kW Emergency diesel generator	5406kg/h	NOx – 0.21 % wt CO_2 – 8.00 %wt CO – 0.05 %wt SO_2 – 0.10 %wt PM10 – 0.01 %wt

Assessment

Ambient air quality impacts were assessed based on a comparison with human health-based standards. Based on a conservative, screening-level assessment, maximum predicted concentrations of combustion-related pollutants at identified receptors and attendant ambient air quality impacts associated with the Prelude FLNG facility are concluded to be of low magnitude. The maximum predicted concentrations of NO_x, SO_2 and $PM_{2.5}$ at Browse Island are well below the associated ambient air quality standards.

Air emissions from the Prelude FLNG facility will also lead to increased deposition of NO_x, SO_2 and $PM_{2.5}$ on the water surface and potential impacts on seawater and seabed sediments and other habitats for aquatic vegetation. However due to the low levels of the contaminants and expected water column dilution and buffer capacity of sea water it is unlikely that deposition emissions will cause a significant change in pH affecting marine life.

Modelling of the emissions from the FLNG facility was also done for safety and occupational health purposes to assess potential impacts to workers aboard the FLNG facility. The occupational health modelling results indicate that the emissions will not result in health and safety issues within the FLNG process area and living quarters. This further supports that emissions from the facility is not likely to have impacts on environmental sensitive receptors.

Given the above, no adverse environmental effects are anticipated and overall, the associated impacts are expected to be slight and the residual risk is assessed to be low.

Control Measures

- The boilers are designed to IFC Guidelines for Thermal Power; the essential generators to IFC General EHS Guidelines; and the emergency generators to MARPOL 73/78 Annex VI;
- The boilers are designed to preferentially use natural gas, and diesel will only be used during turn-arounds, shutdowns and initial installation period when no gas available;
- Low sulphur diesel will be used on the FLNG facility;
- Surveillance program is in place for the boilers to ensure that they are operating efficiently;
- The boiler emissions are monitored through Predictive Emissions Monitoring. In addition, boiler exhausts are equipped with sampling ports for portable monitoring devices for NOx, SOx, CO_2 and PM monitoring if manual stack sampling is required;
- Preventive maintenance requirements are defined and implemented to ensure efficient operations of the power generation systems;
- All vessels utilised on the project comply with MARPOL 73/78 Annex VI Regulations for the prevention of air pollution from ships; and
- Fuel usage is recorded continuously, allowing performance issues to be identified and ensuring engines are operating efficiently and thereby minimising emissions.

4.4.2. Flaring

Activity

During start-up and shutdown, controlled flaring is required as part of the operational procedures. During normal operations, flaring is only performed as necessary for safety reasons (emergency depressurisation). Flaring will otherwise be restricted and only pilot and purge flare is allowed.

Apart from the pilot flare, the following flaring cases are defined:

- Emergency depressurisation – In certain and infrequent circumstances, this represents the maximum flaring rate required to ensure the FLNG facility is brought

to controlled condition as soon as possible. This case results mainly from an emergency shutdown and depressurisation in the plant.

- Operational flaring – Operational flaring results from controlled operational events such as start-up, normal shutdown, system upset, manual controlled blowdown, venting, downgraded operation, purging, draining of equipments and pipe work. During start-up, there is periodic flaring until the process reaches steady state and stable operations. In case of a system upset, operational flaring for a short period enables continued plant operation without total facility shutdown during the time required to rectify the problem.

The flare has a combustion efficiency of 98%. The flare stack is located with a height of 155m.

Assessment

It is important to note that the infrequent flaring of gas is necessary for safe operations and therefore is in itself a mechanism to avoid potential environmental impacts. This avoidance measure is not without impact; however the environmental risks associated with flaring are much lower than the safety and environmental risks associated with not having a safe way to dispose of pressurised gas at the Prelude FLNG facility.

There is minor, localised impact on the air quality at the Prelude location, but this can be assessed as slight.

Control Measures

- Focus on high availability of the process to avoid or minimise any operational flaring.
- The flares are designed to be smokeless.
- Flaring emissions are monitored through Predictive Emissions Monitoring System. Actual flaring emissions are monitored and targets are reviewed annually.
- Controlled flaring during emergency shutdowns and start-ups.

4.4.3. Amine treatment off gas venting

Activity

Prelude gas contains approximately 9 mol% CO_2, and the Prelude process results in a vent gas stream with approximately 95% CO_2. The hazardous stream is both an asphyxiant and toxic. The vent gas outlet is located in the Flare stack structure releasing vent streams at about 150m height (20m below the flare tip).

Assessment

There are a number of issues related to amine treatment off gas disposal. These cover both environment and safety and they are not aligned i.e. there is a trade-off between optimising safety and minimising environmental impact.

The main environmental issue is release of a large quantity of greenhouse gases. Overall these represent a minor contribution to atmospheric greenhouse gas and other air emissions with no local receptors are impacted.

Control Measures

- ALARP demonstration for amine treatment off gas venting vs. reinjection indicated that no technical and economical solution existed for re-injection as no suitable sequestration site was available.

- Monitoring of the amine treatment off gas vent emissions is done through Predictive Emissions Monitoring System.

4.4.4. Fugitive Emissions

Activity

Fugitive emissions from facilities can be defined as releases not confined to a stack, duct or vent. These emissions generally include equipment leaks, emissions from bulk handling of products and a number of other industrial operations.

Fugitive emissions sources are:

- Connectors and flanges
- Valves.

On the Prelude FLNG facility, pumps and compressor seals on hydrocarbon services are closed systems provided with double or tandem seals. Most Pressure Relief Valves on hydrocarbon lines are connected to a closed-flare system. Therefore, fugitive emissions are not expected from these sources.

Assessment

Fugitive emissions are estimated to be a minor part of overall emissions and comprise methane (CH_4), and non methane (VOCs). .

These emissions are subject to rapid dispersion in the offshore atmospheric environment and the potential for impact on local receptors is negligible.

The contribution of the fugitive emissions to the total emissions from the FLNG facility is minor, and the environmental impact is considered negligible.

Control Measures

- Design of the FLNG facility is such that fugitive emissions are minimised. This includes pumps with double seals, minimum number of flanges, use of relief valves instead of open vents in storage tanks, and closed sampling systems.
- Leak testing of all systems prior to introduction of hydrocarbons.
- Maintenance, routine monitoring/inspection regimes.
- Leak Detection and Repair program to be established for the Prelude FLNG facility which includes routine monitoring/ inspections to ensure leaks are identified, isolated and repaired.

4.4.5. Total Greenhouse Gas Emissions: Normal Operations

Activity

The process of LNG and LPG production results in emissions of greenhouse gases. LNG has a lower overall CO_2 emissions intensity than other fossil fuels. Emissions to atmosphere from the FLNG facility that contribute to GHG emissions are the following:

- Combustion of gas – for power generation and compression;
- Flaring of gases;
- Disposal of separated reservoir CO_2;
- Fugitive emissions;
- Transportation – in this case, vessels supporting FLNG operations; and
- Diesel drivers which run in essential or emergency situations.

The above sources are discussed in previous sections.

Assessment

Using an FLNG facility to develop the gas reserves has the following advantages regarding energy efficiency:

- Combining the offshore and onshore components into one integrated facility reduces the use of materials (steel, concrete, site preparation, rock dump) to develop the supply chain from wellhead to loaded LNG by about 95%;
- By being located over the gas field, it avoids a long pipeline to shore;
    - This reduces compression requirements during the later life of the field as the reservoir pressure declines;
    - It also avoids the need for dehydration of the gas and condensate to make it suitable for transport in a carbon steel pipeline to shore, removing the glycol system requirement.

The Prelude FLNG facility is energy efficient in comparison to many land-based LNG plants because it uses cold seawater from 150m depth for cooling, uses a dual mixed refrigerant liquefaction cycle, minimises LNG boil-off with short loading lines and reduces gas compression requirements as the facility is located over the gas field. However, Prelude has a relatively high amount of CO_2 in the feedgas at 9% volume which contributes to its overall CO_2 footprint.

The contribution of Prelude FLNG emissions to global GHG emissions is assessed to be medium over the lifetime of the facility.

GHG emissions mitigation was considered at all stages of the project, from concept through design and development to reduce the CO_2 emissions from the FLNG facility during operations. Best practices have been adopted and employed through the engineering design of the project to, wherever economically viable, reduce GHG emissions.

Control Measures

The principal controls will ensure the Development complies with relevant Australian Greenhouse Gas requirements, including the National Greenhouse Energy Reporting (NGER) Scheme Act and the Safeguard Mechanism. In addition the controls will:

- Drive high availability of wells, subsea gathering system and the LNG process and therefore reduce the incidence of trips and losses to flare;
- Optimize the thermal efficiency of the LNG train to reduce fuel usage;
- Provide provisions for monitoring of GHG emissions are monitored and setting and reviewing of annual targets.

4.4.6. Greenhouse Gas Emissions during Commissioning and Start-up

Activity

Following arrival on location, and preceding steady state liquefied natural gas (LNG) rundown, carbon dioxide (CO_2) emissions generated from the Prelude FLNG facility differ significantly from the normal operating levels. CO_2 is generated from eight activities:

- Diesel, vaporised LNG, or well gas combustion required to satisfy energy demand;

- Flaring, or combustion as fuel gas, of vaporized natural gas, or liquefied petroleum gas (LPG), resulting from tank testing and defrosting of certain systems of the FLNG facility, and prior to start-up of compressors;
- Flaring of natural gas due to gas sweeping of the subsea flowlines prior to opening of wells;
- Start-up flaring of gas in excess of fuel gas demand;
- Atmospheric venting of the reservoir CO_2 stripped from the amine treatment gas removal unit; and
- Flaring caused by process trips and subsequent facility re-starts.

Assessment

CO_2 emissions from the CSU sequence selected have been demonstrated to be minimised by importing both LNG and propane prior to start up. This approach has four main advantages over other options that do not involve imports:

- Minimises flaring (at a rate equal to that at which start-up is carried out) for the duration needed to perform cold tank testing and static defrosting of the facility;
- Minimises flaring (at a rate equal to the above) for the amount of time required to make-up enough refrigerant (through the fractionation unit) to liquefy natural gas.
- A shorter duration from arrival on site to achieving LNG rundown (as a result of not needing to perform static defrosting, cold tank testing, and having to make up refrigerant prior to RFSU, as described above);and
- Combustion of natural gas instead of diesel (inherently resulting in less CO_2 emissions) from arrival on site to “ready for start-up” (RFSU, i.e. opening of wells).

It is in Shell’s interest to produce hydrocarbons as efficiently as possible, whilst maintaining safe operations, production capacity and reliability. All of these drivers work towards minimising GHG emissions. Given the short duration of the activity and that the most ALARP strategy has been chosen, the GHG emissions during commissioning phase are considered acceptable.

Control Measures

- Optimised activities to reduce emissions, including minimizing use of diesel fuel; and
- Monitoring of emissions.

4.5. Waste Management

Activity

Offshore wastes generated by the Prelude FLNG project includes:

- Hazardous waste;
- Domestic Waste;
- Office Waste; and
- Industrial Waste

Low level Naturally Occuring Radioactive Materials (NORMs) may occur in sludges associated with the inlet facilities. These sludges are directly removed from the facility for treatment/disposal onshore. Handling and management of potentially NORM-

contaminated wastes is in accordance with the requirements of Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

During major maintenance activities and opening of vessels, there is a potential for mercury-contaminated sludges. As with other hazardous wastes, these will also be managed in accordance with regulatory requirements.

Segregation and characterisation of waste is required to determine similar wastes that can be combined to simplify storage, transportation, treatment, recycling and/or disposal. Waste segregation is established and maintained on the FLNG facility through the provision of labelled bins and skips.

Assessment

Waste storage on the FLNG facility has a capacity to accommodate up to 14 days of waste accumulation during normal operations.

During installation and shutdowns or unplanned maintenance, the amount of waste produced has the potential to exceed the capacity of the designated waste storage facilities. Temporary waste storage storage facilities and handling during these activities are part of specific procedures that have been developed for the activity. A temporary laydown area is used during these activities.

Management of these wastes on the FLNG facility includes the identification, classification, management and handling including segregation, storage and transfer to the supply vessels for onshore disposal. All wastes are sent to shore via the Darwin Supply Base for treatment and disposal in appropriate waste facilities.

Each vessel has its own Waste Management Plan/Procedure to manage wastes generated and stored onboard in accordance with MARPOL Annex V. All wastes from the vessel are also sent to shore for disposal.

No solid wastes from the FLNG facility and vessels are discharged overboard and therefore impacts from the waste management on Prelude FLNG facility is assessed to be slight.

Control Measures

- Shell Australia and Prelude waste management processes ensure cradle-to-grave management of wastes in accordance with regulatory requirements;
- Dedicated wastes storage areas on the FLNG facility and vessels, which are contained;
- Wastes recording and volume monitoring, waste reduction targets; and
- Correct waste management is part of the general HSSE inductions for the FLNG facility and the vessels.

4.6. Emergency Events

4.6.1. Accidental discharge of hazardous waste and chemicals into the ocean

Activity

During the installation and operations of the Prelude FLNG facility, there is the potential for spills and leaks to occur. Spills may result in localised impacts on water quality and toxicity effects on marine fauna and flora.

Chemical handling precautions and vessel management procedures significantly reduce the risk of any spillage to the environment.

Spill kits and containment bunds on the vessels and the FLNG facility are utilised in the event of a spill, and are appropriately located, stocked and maintained. Vessels maintain and implement a Shipboard Oil Pollution Emergency Plan (SOPEP) in accordance with MARPOL 73/78 and regulatory requirements.

The credible scenarios for accidental discharge of hazardous materials to the ocean are:

- accidental operation of isolation valve;
- bulk liquid transfers;
- lifting operations from vessel to vessel and from the FLNG facility to vessels and vice versa; and
- adverse weather conditions whereby material is dislodged from the vessels.

Assessment

The likelihood of a rupture of storage tanks on the FLNG facility is low. Ship collision study and analysis indicate that the frequency of vessel collision in the Prelude area is low. The overall collision frequencies are dominated by the contribution of the low-energy supply vessels. For the double-hulled Prelude FLNG facility, energy levels above 193MJ would be required to cause breach of the inner hull and potential releases of cargo onto the sea surface. This high impact energy level is not likely to occur within the Prelude area.

Hydrocarbon based or chemical spills may result in localised impacts on water quality and toxicity effects on marine fauna and flora. Specific effects on individual receptors would depend upon the type and volume of chemical released, but they are broadly similar to the receptors discussed in relation to hydrocarbon spills.

Significant spill scenarios (release from FLNG's storage tank) for amine (1000m^3) and MEG (6000m^3) releases have been modelled. All other smaller chemical spills (for example from bunkering activity or from lifting of chemical containers) are expected to fall below these significant scenarios.

Dissolved Amine is unlikely to reach Browse Island and Heywood Shoals with a low likelihood (1% probability) for the annualised period.

Dissolved MEG is not forecast to contact any of the assessed sensitive receptors in any season.

The impact of a hazardous materials spill to the marine environment is considered slight to minor and the residual risk low to medium depending on the potential spill size.

Control Measures

- Storage tanks for bulk chemicals are designed for storage of the appropriate chemicals.
- All permanent chemical storage facilities on the FLNG facility have been strength-tested and leak-tested prior to start-up.
- Maintenance regime for the connections, hoses, storage tanks and other critical equipment for chemical storage.
- Bunkering of fluids in accordance with relevant procedures.
- Prelude Lifting and Hoisting Manual and Adverse Weather Standard minimise the risk of releases associated with dropped objects.

- Prelude Oil Pollution Emergency Plan (OPEP) which lays out the response procedures in any chemical and oil spill incidents.

4.6.2. Diesel or fuel spill during vessel bunkering at sea

Activity

It is likely that additional fuel will be taken by the installation vessels and the FLNG facility from support vessels every month (significantly higher during commissioning and start-up).

The probability of spills caused by fuel handling mishaps is low but because of the number of times fuel is handled at sea, overall this is one of the most common sources of spills. Causes include hose rupture, coupling failures or tank overflow. Spillage volume is generally less than 160 litres (1 bbl), and potential quantities are reduced by visual observations, monitoring, shutdown of pumps and automatic closure of safety valves.

Assessment

Marine diesel is a low viscosity distillate fuel. Diesel contains a high proportion of lighter hydrocarbons, such that evaporation is an important process contributing to the removal of spilt diesel from the sea surface. Evaporation is enhanced by higher wind speeds and warmer sea and air temperatures. Approximately 40% of the diesel by mass is predicted to evaporate over the first two days, depending on the prevailing conditions.

Hydrocarbons vary in their impacts depending on volumes, toxicity, solubility and persistence, and rate and stage of degradation. Diesels and fuel oil to be used are light products with high evaporation rates when discharged at the ocean surface, especially in warm tropical waters.

The most toxic components in oil, although having the highest solubility in water, tend to be those that are lost most rapidly through evaporation when oil is spilled. Because of this, concentrations of toxic components leading to large-scale mortalities of marine life are relatively rare, localised, and short lived and only likely to be associated with spills of light refined products or fresh crude.

Potential effects of hydrocarbon on habitats and wildlife can be broadly summarised as:

- direct physical and chemical alteration of natural habitats;
- direct physical effects on flora and fauna;
- direct toxic effects and physiological effect on flora and fauna; and
- indirect changes on flora and fauna resulting from changes to prey and predator and habitat alterations.

Benthic Communities

Benthic communities in deeper waters are largely separated from surface slicks by the water column and remain unaffected. Potential exposure to subsurface waters may occur due to the development of dispersed oil droplets and dissolved hydrocarbon fractions. However, the most toxic and also most volatile components of diesel are expected to evaporate rapidly from a surface slick. Therefore, concentrations of the fractions which may be dissolved or entrained in the water column can be expected to rapidly diminish with depth below surface slicks.

Given these, benthic fauna are unlikely to be exposed to acutely toxic concentrations of dissolved hydrocarbon fractions as concentrations rapidly decrease to low levels beneath a slick (a few ppm or less).

Fish and fishers

In the open ocean, most pelagic fish and all demersal fish live relatively deep in the water column and are unlikely to contact surface spills or be exposed to acutely toxic concentrations of dissolved hydrocarbon fractions as concentrations rapidly decrease to low levels beneath a slick (a few ppm or less). There is the possibility pelagic fish are able to detect and avoid waters underneath oil spills by swimming away from the affected area. Fish mortalities are more likely in sheltered bays where there is limited water exchange rather than in the marine offshore environment such as the Prelude location. As a result, wide-ranging pelagic and demersal fish are not highly susceptible to impacts from surface hydrocarbon spills.

Any impact to fish has a potential impact to the fishing industry. As the permit area does not contain any recognised feeding, breeding or aggregation areas, it is therefore is unlikely to support significant numbers of identified endangered/ migratory species.

Cetaceans

Cetaceans surface to breathe air and are therefore potentially vulnerable to exposure to a hydrocarbon slick on the sea surface, particularly vulnerable are their respiratory systems and nervous systems. They are relatively smooth-skinned and hairless so contact with spilt hydrocarbon on the surface and in the water column should not stick to their skin or affect insulation. More likely results are potential sub-lethal impacts such as minor adherence, irritation and adsorption, but there is potential for impact to eyes and airways. Inhalation of vapours or the ingestion of hydrocarbons can potentially be lethal to cetaceans. However, cetaceans are highly mobile, capable of long migrations, and only occur in low numbers in the permit area.

Impacts on cetaceans from entrained oil depend on their spatial and temporal distribution and feeding preferences at the time of the spill. Humpback, blue and the other baleen whales are unlikely to be feeding as they migrate so impacts should be limited to direct contact with hydrocarbons.

Given such sparse distributions of cetaceans in the Browse Basin area, it is not anticipated that significant impacts would result to regional cetacean populations if a spill was to occur.

Reptiles

Turtles are air breathers and smooth skinned so contact with hydrocarbon on the surface and in the water column is likely to result in sub-lethal impacts such as minor adherence, irritation and adsorption.

At sea, turtles are potentially vulnerable to the effects of hydrocarbon spills at all life stages as they are frequently making contact with the sea surface for resting or feeding.

Potential impacts from hydrocarbon spills reaching nesting sites, including Browse Island, may result in disruption, alteration or destruction of their incubating young. If oiling is heavy and penetrates sediments, nests may be contaminated resulting in oil permeating through shell membranes and contaminating emergent hatchlings, which may affect subsequent generations. Browse Island is the nearest known turtle breeding, nesting, and feeding grounds.

Due to the properties of marine diesel, heavy oiling is not an impact that is expected. In addition, it is not expected that turtles and sea snakes are present in large numbers in offshore waters in the Browse Basin.

Seabirds and shorebirds

Seabirds and shorebirds have a potentially higher risk of contact with spilled hydrocarbons due to the amount of time they spend on or near the surface of the sea and on affected foreshores. Contact with hydrocarbon may potentially impact a bird's ability to fly due to external and/ or internal exposure potentially leading to death by drowning, starvation or predation. Hydrocarbon contamination affects the feathers insulation, buoyancy and waterproofing properties and ultimately the bird's survival. As an affected bird preens, it ingests and inhales hydrocarbons, which can cause damage to internal organs such as the lungs, intestines and liver. Suppression of the immune system can also occur and other effects include impacts to reproductive success through decreased fertility of eggs and reduction in egg shell thickness.

Specifically, estimates for the minimal thickness of floating oil that might result in harm to seabirds through ingestion from preening of contaminated feathers, has been estimated by different researchers at approximately 10g/m^2 to 25g/m^2.

Mass mortalities however are not expected given the low reported density of shorebirds and seabirds in the area and the fact that no known seabird or shorebird breeding colonies are present in the area.

The main area of sensitivity for migratory birds are the Ashmore Reef and Cartier Islands, which are recognised as particularly important for feeding migratory shore birds during non–breeding periods. Browse Island, and Seringapatam and Scott Reefs are also recognised as important habitat for seabirds. However, due to the distances from the installation (~40-150km), impacts are considered highly unlikely.

Coral

Subtidal corals avoid direct contact with surface oil slicks but can be exposed to the entrained and water soluble hydrocarbon fractions if these hydrocarbons are entrained at the same depths. The water soluble hydrocarbon fractions are mostly limited to the lighter compounds, particularly aromatic hydrocarbons such as benzene and toluene. However, these lighter compounds are more likely lost to evaporation rather than remaining in the water column.

Subtidal corals are therefore less likely to suffer lethal impacts but may potentially still be affected by sublethal effects. The planktonic stages (spawned gametes and larvae) of coral are more susceptible to hydrocarbon spills because of their tendency to float or remain near the water surface thus bringing them into direct contact with surface slicks. Coral planktonic stages of mass spawning species are largely confined to a 1 to 3 week period after spawning which generally occurs in March/ April. A spill outside of this period is of less concern for coral planktonic stages.

Compared to subtidal corals habitats, reef flat communities generally have the lowest coral cover and lowest diversity of corals on a reef system due to the harsh conditions for coral growth which includes regular tidal exposure and extensive wave action (particularly along the west coast of Australia). As hydrocarbon ultimately floats to the ocean surface, the most vulnerable coral colonies to direct contact with hydrocarbon spills are intertidal corals found on the reef flat, which are periodically exposed during low tides. As such, whilst the reef flat habitat is the most vulnerable coral habitat to direct contact to spills, it is also regarded as the least sensitive of the shallow coral habitats.

The intertidal and shallow water coral reef species at Browse Island, Heywood and Echuca Shoals and other nearby reefs and shoals could potentially suffer sub-lethal stress and, depending on the exposure time and concentration, potentially high rates of mortality. The exposure time and concentration is a function of the location, including the distribution of entrained and dissolved hydrocarbons throughout the water column, and extent of the spill and the metocean conditions at the time of the spill and in the days and weeks following it.

Coastlines

Rocky shores, including beach rock, generally are not heavily impacted by hydrocarbon contact as wave reflection keep some oil offshore and any deposited oil weathers and is removed rapidly by wave action. Sandy beaches may be affected by hydrocarbon contact. Low viscosity oils may penetrate deeply, and if it is heavier oil, an asphalt-like pavements may develop if left alone, which may persist for many years on a low energy beach. Oil may be weathered and removed rapidly, or become buried and removed slowly. Wave cut rock platforms (like those surrounding Browse Island) may be exposed to landed oil, which should weather rapidly, it may collect in pools and be redistributed on rising tide.

In the event of a shoreline oiling, the persistent fraction in the hydrocarbon would be expected to accumulate on the shore and would percolate into the sand and any fauna burrows. Hydrocarbons would spread deeper where sands have coarsest grain size. Water saturated sands at the low shore would be generally less susceptible to penetration than drier sands on the high shore. Exposure of the unstable coarse-grained sandy shore to wave action will typically disperse and remove hydrocarbons from surface layers whereas hydrocarbons that have filtered deep into the sand may have a prolonged persistence. Shoreline oiling would have initial acute impacts on intertidal faunal assemblages, expected to be dominated by burrowing invertebrates (such as gastropods, crustaceans and polychaetes), but as spills disperse, intertidal communities would be expected to recover.

Thresholds

The thresholds used in this EP to present the stochastic modelling of hydrocarbon spill results, below which concentration impacts are not predicted, are floating oil: 10g/m^2, dissolved oil: 400ppb; and entrained oil: 500ppb. The lower threshold of floating oil of 1g/m2 is likely to be an indicator of where there is a visual presence of an oil slick (rainbow sheen), however there is little potential for environmental impact.

Modelling of diesel spill due during bunkering

Spill modelling for a diesel spill of up to up to 2.5m^3 volume at the sea surface, which is more than is likely to be spilt during a refuelling spill, shows that the spill does not reach any emergent features at instantaneous floating oil concentrations with a probability of 0.5% or above in any season. Floating oil does not occur at any distance greater than 12km from the spill site.

Approximately 40% of the diesel by mass is predicted to evaporate over the first two days, depending on the prevailing conditions. Annualised probabilities are less than 0.25% for dissolved concentrations greater than 6ppb and entrained hydrocarbon greater than 10ppb in waters around the spill site or at any sensitivity.

Given the open ocean location and low volumes of fuel spillage, no significant impacts to reptiles, fish, cetaceans or benthic communities are expected as a result of a refuelling spill. Potential impacts are expected to be limited to localised reductions in water quality, and minor toxicity to marine fauna if present at the early stages of the

spill at the surface close to the spill source. The overall impact is considered slight to minor depending on the spill volume and the residual risk is assessed as medium.

Control Measures

- Use of dry break couplings.
- The FLNG facility and vessel re-fuelling procedures that include communication systems, continuous visual monitoring of hoses and connections, commencement of operations in daylight, fuel hose inspections and testing.
- Prelude Oil Pollution Emergency Plan (OPEP) which lays out the response procedures in any chemical and oil spill incidents.
- Shipboard Oil Pollution Emergency Plan (SOPEP) shall be in place for the vessels.

4.6.3. Diesel spill resulting from a collision with another vessel

Activity

Vessel traffic to/ from the project location poses a potential collision risk with other vessels. Grounding risk is not considered a credible scenario within WA-44-L due to the deep water ~237m. Several vessels will be in the field during the activities.

Consequences of a vessel to vessel collision could potentially include loss of hydrocarbons from a fuel tank rupture, though the collision risk is low.

The risk of a spill from vessel to vessel collision depends on the severity, i.e. speed and aspect of the vessels during the event. The vessels chosen for the Prelude activity are typical operational support vessels that have diesel storage capacities of around 1,000m^3 for refuelling operations, stored in multiple tanks. The worst case scenario is if one of the vessels is 'hit' from the broadside by another vessel moving at near full speed resulting in a puncture of the diesel tanks below the waterline.

The biggest diesel storage tank on the FLNG facility has a capacity of 750m^3 and is located in the substructure. As a result of a vessel collision, a fuel spill arising from the rupture of this single tank with the largest fuel capacity has been considered as the worst credible diesel spill scenario.

Assessment

The Prelude project represents a minor increase in the existing low collision risk associated with current maritime traffic in the region. The likelihood of a cargo release from the double-hulled FLNG is low, given the design.

Effects of hydrocarbon on habitats and wildlife in the open ocean environment are described in Section 4.6.2. Whilst the zone of potential impact is increased, the effects are expected to be similar.

A spill modelling for 750m^3 of marine diesel has been done for Prelude FLNG. The spill modelling shows that floating oil greater than 10g/m^2 is expected to remain within a 60km radius of the spill site. The annualised probability of floating oil greater than 10g/m^2 is less than 0.5% at all sensitive receptors. There are potential oiling impacts for birds within the 60km radius of the spill site if the birds are at sea, particularly during the migratory periods October-November and March-April. However, oiling impacts to nesting sites are highly unlikely to occur.

Reptiles such as green turtles, particularly in summer, foraging near Browse Island may be impacted. Contact with diesel may cause burns, eye irritation, neurological signs, and lung damage from inhalation of fumes from heavy oil as it evaporates from the surface of the water. The annualised probability of entrained oil greater than

500ppb is less than 0.5% at all sensitivities. The annualised probability of dissolved aromatic hydrocarbons greater than 400ppb is less than 0.5% at all sensitivities.

Given the open ocean location, low likelihood, low concentrations at sensitive locations, and limited volumes of fuel spillage, the potential impacts are limited to localised reductions in water quality and a low probability of smothering and/ or poisoning of marine fauna. The impact of a collision resulting in a spill is considered moderate and the risk ranked as medium.

Control Measures

- The FLNG facility and support vessels will be equipped with radar, ARPA and navigation systems.
- The Safety Zone around the FLNG facility will be monitored by two infield support vessels equipped with radar and ARPA.
- All vessels employed for Prelude are subjected to a stringent inspection and assurance prior to engagement.
- Collision controls during any simultaneous operations with vessels are in place such as Permit to Work.
- Product off take tankers during berthing/offloading/de-berthing are assisted by Prelude deployed pilots and positioned by the in-field support vessels to reduce the risk of colliding with the FLNG facility.
- The Prelude Oil Pollution Emergency Plan (OPEP) lays out the response procedures for any chemical and oil spill incidents.

4.6.4. Heavy Fuel Oil Loss of Containment from Product Offtake Tankers

Activity

The product offtake tankers potentially carry heavy fuel oil (HFO) as fuel. Grounding risk is not a credible scenario due to deep water. Any HFO spill will result from a collision of the tankers with other vessels. Given the average volume of HFO stored in LNG carriers (up to 5,000m^3) and the low energy collision credible whilst attached to the FLNG facility, a 1,000m^3 HFO spill was modelled. This is considered highly conservative given impact energy are highly unlikely to result in such a significant breach.

Assessment

The effects of hydrocarbons on habitats and wildlife in the open ocean environment are described in Section 4.6.2. Whilst the zone of potential impact is increased, the effects are expected to be similar.

Spill modelling for 1,000m^3 of HFO indicates that floating oil at 10g/m^2 is forecast to extend up to 300km west/southwest and 500km east/northeast. Browse Island is most likely to be contacted at 0.75% probability. Therefore, there are potential oiling impacts for birds if the birds are at sea and in the nesting sites, particularly during the migratory periods October-November and March-April.

Entrained oil at or above 500ppb and dissolved aromatic hydrocarbons at or above 6ppb are not forecast to occur within any of the assessed sensitive receptors.

This modelling presents a conservative scenario as it does not take into account the following:

- Low likelihood of HFO release due to ship collision;

- Shell's spill response measures that reduce the likelihood of oil reaching coastal habitats (see OPEP).

Whilst the likelihood of a worst case scenario is low, the event could release significant volumes of hydrocarbon to the marine environment leading to a major impact and a medium residual risk.

Control Measures

- The FLNG facility and vessels will be equipped with radar, ARPA and navigation systems.
- The Safety Zone around the FLNG facility will be monitored by two infield support vessels equipped with radar and ARPA.
- All vessels employed for Prelude are subject to a stringent inspection and assurance prior to engagement.
- Collision controls during any simultaneous operations with vessels are in place such as Permit to Work.
- Product off take tankers during berthing/offloading/de-berthing are assisted by Prelude deployed pilots and positioned by the in-field support vessels to reduce the risk of colliding with the FLNG facility.
- The Prelude Oil Pollution Emergency Plan (OPEP) lays out the response procedures for any chemical and oil spill incidents.

4.6.5. Hydrocarbon Loss of Containment from the Prelude FLNG

Activity

There are four product streams that are produced on the Prelude FLNG faciltiy: LNG, LPG (propane and butane) and condensate. During production, all four product streams are rundown to their respective cargo storage tanks at atmospheric pressure within the substructure. During offloading, only one product stream is offloaded at any one time.

Any LNG or LPG leaks from the topsides process modules or any hydrocarbon release from the cryogenic areas go directly the sea to protect the facility from damage due to cryogenic spills. However, any condensate spills are contained in the closed drain system.

Assessment

Effects of hydrocarbon on habitats and wildlife in the open ocean environment are described in Section 4.6.2.

LNG and LPG are clean, non-polluting, products and create no danger to the marine environment. If however LNG spills on to the sea, this may create large quantities of vapour as sea water rapidly vapourises the liquid to gas.

Condensate comprises the fraction of the produced hydrocarbon that is a liquid at ambient temperature and pressure. It is comprised of low molecular weight hydrocarbons and has similar characteristics as light diesel fuel. It is typically volatile and evaporates readily. However, the condensate anticipated for Prelude has a waxy component which may persist after the volatile portion evaporates. Condensate spreads rapidly and may be impractical or difficult to contain at sea.

Condensate loss from the FLNG facility can either be:

- Up to $10m^3$ from inadvertent disconnection of a coupling or flange at the topsides process modules and failure to contain by spill trays and the closed drain system;

- Up to 1000m^3 for condensate offloading operation by floating hose. At a loading rate of 5,000m^3 per hour, these quantities reflect a major loss of containment from rupture of loading hose and failure to respond inside 15 minutes.
- Large release of cargo due to vessel collision.

The last scenario is considered as worst-case scenario and therefore, has been modelled for assessment.

A release of Prelude Condensate at the surface following a complete rupture of two storage tanks after a vessel collision has been modelled.

Floating oil at 10g/m^2 is forecast to extend up to 460km west/southwest and north/northwest. Browse Island is most likely to be contacted at 3% probability. Therefore, there are potential oiling impacts for birds if the birds are at sea and in the nesting sites, particularly during the migratory periods October-November and March-April.

Entrained oil at or above 500ppb is generally forecast to extend up to 900km from the release site, with the potential of extending up to 1,700km to the west-northwest of the release site. For this threshold, Browse Island is most likely to be contacted at 16.75% probability. Dissolved aromatic hydrocarbon concentrations at or above 400ppb are generally forecast to extend up to 300km from the release site, with the potential of extending up to 600km to the southwest of the release site. At this threshold, the highest probability of contact is forecasted for Heywood Shoal at 0.75% and for Browse Island at 0.5%.

Whilst the likelihood of a worst case scenario is low, the event could release significant volumes of condensate to the marine environment leading to a major impact and a medium residual risk.

Control Measures

- The FLNG facility is double-hulled and the condensate storage tanks are surrounded by ballast water tanks which provide added protection in case of a breach of the hull.
- The drainage system reduces the risk of spills which do occur reaching the ocean.
- Robust design of offloading arms and hoses which reduces the risk of spill associated with offloading products.
- Ship-to-shore communications system and Emergency Disconnect System in place for LNG/LPG offloading.
- Maintenance regime for the connections, loading arms, hoses, storage tanks, drains and other systems required for offloading.
- Berthing trial during commissioning to test offloading systems and procedures.
- Prelude Terminal Handbook and associated procedures.
- Prelude Oil Pollution Emergency Plan (OPEP) which lays out the response procedures in any chemical and oil spill incidents.

4.6.6. Hydrocarbon Loss of Containment from Subsea Facilities

Activity

During installation, normal operations and maintenance activities, installation and support vessels could be near the subsea facilities and potential dropped objects onto the subsea equipment could result in release of hydrocarbons. During the course of

lifting a heavy equipment item, there is the potential for the item to be dropped or to swing uncontrollably. In addition, during severe weather conditions there is the potential for heavy equipment items at height to break loose.

Subsea release of hydrocarbons can result from breach of the manifolds, flowlines or the wellheads. The worst case scenario is associated with release from the wellhead, or damage to the wellhead from a dropped object. There are two release scenarios: the first is a release from the 500m section of production tubing between the wellhead and the Surface Controlled Sub-Surface Valve (SCSSV). This would be a limited inventory and the release durations would be expected to be relatively short. The second would be where the SCSSV fails in the open position and then any release from the wellhead is effectively linked directly to the reservoir with indefinite inventory available for release.

The flow rate in the worst case scenario is 20,000 bbl/day of condensate, yielding a total release volume of 1,600,000 bbl. This rate is based on the modelled maximum rate of gas flow expected from the most productive of the seven Prelude wells, and the number of days (80 days) to drill a relief well in case of loss of well control.

Assessment

The accidental loss of large amounts of natural gas into the water column during a hydrocarbon release from the wellhead similar to a well blow-out could have a temporary impact on marine benthos, fish and plankton within the vicinity of the accident site. There are few studies on the biological effects of natural gas on biological organisms and communities.

Of greater environmental concern than the release of gas into the water is the release of associated condensate. Whilst the likelihood of the worst case scenario is remote, the impact of a major hydrocarbon release and the significant volumes of condensate to the marine environment could be major and the residual risk is considered high. A subsurface release of condensate can result in condensate distributed within the water column, not just on the ocean surface.

Modelling indicates that the distance from the spill site of concentrations above 10g/m^2 is 10km and that there is <0.5% chance that films arrive at sensitive receptors with concentrations greater than 10g/m^2. Oiling to birds is not considered likely outside of a 10km radius. During migratory periods, there may be some birds at risk of oiling, however the impact is not expected to be extensive. Given the distances to sensitive locations, impact on foraging turtles is not expected.

Entrained hydrocarbons > 500ppb may travel considerable distances and are expected at all sensitivities, many with probabilities greater than 50%. Being a subsea blowout and as 80% of the spill volume is predicted to remain entrained, condensate is likely to be entrained at significant depths and therefore impact shoals potentially to significant depths.

Given the open ocean environment with large tides and long durations to impact; high concentrations of hydrocarbons at a fixed location is considered unlikely. Subtidal shoals may experience sublethal or lethal impacts, with the largest impacts being expected in March or April when the mass spawning is expected to take place. Impacts to foraging turtles are expected to be limited to sub-lethal impacts such as minor adherence, irritation and adsorption. Cetaceans and fish may be impacted by coming into contact with high concentrations of hydrocarbon (dissolved or entrained), however populations are widespread and significant impacts across entire populations are not expected.

The worst case scenario modelling used as a basis for the above discussions presents conservative scenarios, as they do not take into account:

- the low probability of a hydrocarbon release from the wellhead due to dropped object occurring during installation, normal operations and maintenance activities, given the mitigation measures that are adopted;
- the presence of Well Containment Systems, which provide containment of the hydrocarbon envelope in the subsea wells. The Safety Critical components of Well Containment for Production Wells are as follows:
    - Xmas Tree Underwater Safety Valve (USV) – can be either the Production Master Valve or Production Wing Valve;
    - SCSSV
- Shell's spill response measures that will help reduce the likelihood of oil reaching coastal habitats (see OPEP).

Whilst the likelihood of a worst case scenario is low, the event could release significant volumes of condensate to the marine environment leading to a major impact and a medium residual risk.

Control Measures

- Global Standards for Well Design Integrity
- Rigorous lifting procedure has been developed by Shell to prevent the risk of dropped objects.
- The design, layout and location of the Prelude subsea facilities reduce the risk of any dropped objects damaging any subsea equipment.
- Non-corrosive materials selected for wellheads, and fail-safe design of the shutdown valves.
- Prelude Oil Pollution Emergency Plan (OPEP), which lays out the response procedures in any chemical and oil spills.
- Prelude Well Capping and Containment Plan that documents Prelude specific well capping mobilisation and deployment options and relief well locations, rigs and drilling strings.

5. Environmental Plan Implementation Strategy

5.1. Management Systems and Contractor Management

The Shell Commitment and Policy on Health, Safety, Security, Environment and Social Performance (HSSE and SP) applies across Shell globally and is designed to protect people and the environment.

Key features of the policy are:

- Systematic approach to HSSE and SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Targets for improvement and measurement, appraisal and performance reporting;
- Requirement for contractors to manage HSSE and SP in line with this policy; and
- Effective engagement with neighbours and impacted communities.

All of Shell's operations comply with the Shell HSSE and SP Control Framework, a comprehensive corporate management framework, comprising a set of mandatory standards applicable to every Shell Company, contractor and joint venture under Shell's operational control.

Management of HSSE on the Prelude FLNG facility is through the implementation of the Shell Australia HSSE MS, supplemented by facility/asset specific HSSE systems/procedures (e.g. Prelude Permit to Work system and associated procedures such as Confined Space Entry, Isolations, etc.).

The Shell Australia Permit to Work system and associated procedures are used to manage all activities and associated risks on the facility.

For the activities that occur offshore but not on-board the Prelude FLNG facility (e.g. ISV and MSV activities within the safety zone, mooring installation, station keeping, riser pull in, maintenance activities), Vessel Contractors predominantly use their own vessel/facility HSSE-MSs to manage work scope onboard their vessel.

Depending on the scope of work to be conducted, offshore activities executed by Contractors may require an authorized Permit to Work from the Prelude FLNG facility. In addition, every vessel entering the safety zone requires authorization from Prelude.

Some Contractors operate within their own HSSE-MS that is consistent and in some areas bridged to the Shell Australia HSSE-MS. There are specific Contractors' procedures that are interfaced to that of the Prelude FLNG Facility, e.g. Vessel Emergency Response Plan. These procedures are reviewed by Shell, and assured to ensure they meet minimum requirements, the proper interfaces are in place and personnel are aware of their roles and responsibilities.

Shell implements specific pre and post contract award processes and activities aimed at ensuring that contracts consistently and effectively cover the management of HSSE & SP risks, and deliver effective management of HSSE & SP risks for contracted activities. Contractor HSSE & SP Management is governed by the Shell HSSE & SP Control Framework.

As a minimum, all contractors' HSSE-MS have been assessed to meet the requirements of the Shell Group HSSE & SP Control Framework.

5.1.1. Management of Change (MOC)

Management of change (MOC) is a compulsory Shell Asset Integrity-Process Safety Management requirement to avoid incidents resulting from unforeseen consequences of Process Changes, Procedural Changes or Organisational Changes. Changes must

be fully documented and reviewed by competent and authorised staff, prior to decision and communication of the change to all relevant parties, and execution.

All changes presented under the MOC process require Health, Safety, Security, Environment &Social Performance (HSSE&SP) screening and endorsement. If a change is considered significant as per Regulation 17 (5) or (6) then a revised or new EP will be submitted to NOPSEMA for acceptance.

5.1.2. Competency

All personnel required to work on the Prelude installation activity are employed on the basis they are competent to do their job.

Within Shell, the HSSE and SP Control Framework requires people in HSSE Critical Positions to have their HSSE-MS competence assured. These people have to attain a set proficiency level in three competences: HSSE Lead; HSSE Prepare; and HSSE Apply. People in HSSE Critical Positions are responsible for the development and maintenance of effective barriers to prevent incidents.

Contractors have their own Competence requirements in place. Training records of all personnel will be maintained and the training program will be reviewed on a regular basis.

5.2. Arrangements for Ongoing Monitoring of Environmental Performance

This section outlines the measures undertaken by Shell to regularly monitor the management of environmental risks and impacts of the Prelude activities against the performance outcomes, standards and measurement criteria, with a view to continuous improvement of environmental performance. The effectiveness of the Management System is also reviewed periodically as part of the monitoring and assurance process.

In addition, Shell Australia is also required to do annual greenhouse gas emissions and energy usage and pollutants emissions under the National Greenhouse Gas and Energy Reporting Scheme (NGERS) and National Pollutant Inventory (NPI) reporting, respectively.

5.2.1. Prelude Liquid Discharges Monitoring Program

The main objective of the liquid discharges monitoring program is to support the ongoing management of liquid discharges from Prelude continuously to ALARP and to validate the predicted impacts of the Prelude liquid discharges, including cumulative and additive impacts as a result of potential co-mingling of the discharges. The monitoring program will include the studies/activities detailed in Table 11.

Table 11: Prelude Liquid Discharges Monitoring Activities and Studies

Study/Activity	Objectives	Timing
Routine operational monitoring of dosing and discharges	To gather real operational data on contaminant concentrations and discharge flowrates to: confirm accuracy of inputs into risk assessments and identify the need for additional studies to understand impacts if discharge concentrations and flowrates have been underestimated confirm compliance with approvals and identify non-compliance to enable continuous management of individual waste streams to ALARP reduce the likelihood of additive impacts by managing individual discharge stream impacts to ALARP	Upon start-up, then ongoing throughout operations at agreed intervals PFW: online analyser for OIW and flow, manual sampling and analyses Bilge/MARPOL system: online analyser for OIW and flow Brine: online analyser for flow and temperature Sewage: Monthly sampling and analysis Cooling water: Online analyser for residual chlorine and temperature, and flow
Meteorological data and FLNG orientation/ positioning	To gather site specific data to: confirm accuracy of inputs into discharge models used in risk assessments and identify any need for updating models aid the design of field sampling program	Upon start-up, then ongoing throughout operations Prelude has a Weather Monitoring System (WMS) for real-time monitoring of weather conditions in the field.
PFW Chemical Characterisation Cooling Water Discharge Characterisation Desalination Brine Characterisation	To determine chemical constituents and concentrations to: compare against assumptions made in risk assessments and identify the need for additional studies to understand impacts if discharge concentrations have been significantly underestimated compare composition of Prelude PFW against other NWS and global PFW discharges provide data to elucidate on PFW toxicity (see below) monitor changes in chemical composition through time aid the design of field sampling program by identifying suitable chemical tracers to target in field sampling and expected mixing zones	For PFW, after steady state, then annual. For the cooling water and brine discharges, once-off once FLNG is on steady state and representative samples can be collected. Tests to coincide with Whole Effluent Toxicity (WET) testing Upon changes (new well, change in process chemicals, water break through etc.)
PFW WET Testing	To determine toxicity of PFW to: compare against predictions made in risk assessments and identify the need for additional studies to understand toxicity if significantly underestimated compare toxicity of Prelude PFW against other NWS and global PFW discharges understand likely major contributors to overall toxicity monitor changes in toxicity through time aid the design of field sampling program by	Commencing within 2 months of steady state operations, then quarterly for first 18 months, then triennial Upon changes (new well, change in process chemicals, water break through etc.)

Study/Activity	Objectives	Timing
	identifying expected zones of impact around discharge	
Water Column Sampling	To: Determine background contaminant concentrations in the water column at suitable control sites Determine actual contaminant concentrations and dilution rates of discharges, compare against predictions made in risk assessment and update risk assessment as necessary Identify areas of co-mingling of different discharge plumes and determine actual contaminant concentrations and dilutions in mixing zones to evaluate potential additive impacts aid the design of the 'mixed discharge' WET testing	After the chemical characterisation and WET testing as these will help identify chemicals to be surveyed Two sampling events within 5 years (first one nominally within 18 months after commencement of steady state) Sampling could coincide with chemical characterisation and WET testing
Sediment Sampling	Determine background contaminant concentrations in the sediments at suitable control sites Determine the combined 'chronic impacts' of all contaminants in all discharges, including any additive or cumulative effects	After the chemical characterisation, WET testing as these will help identify chemicals to be surveyed Two sampling events within 5 years (first one nominally within 18 months after commencement of steady state)
'Mixed discharges' WET Testing	To determine toxicity of comingled discharges to: Understand if comingled discharges have significant additive or synergistic impacts Understand likely major contributors to overall toxicity in comingled discharges	Once off, after initial field water sampling survey and coinciding with next scheduled PFW WET testing

5.2.2. Air Emissions Monitoring Program

Table 12 describes the monitoring program for the air emissions from the Prelude FLNG activities.

Table 12: Air Emissions Monitoring for Prelude FLNG Facility

Source	Parameters monitored	Frequency	Description
Emissions from boilers	Total fuel gas consumed GHG emissions Particulate matter (PM) Sulphur dioxide (SO_2) Nitrous oxide NOx) Carbon monoxide (CO)	On-line	Predictive Emissions Monitoring System from the following parameters measured online: • Fuel flow • Fuel quality • Air flow (or fan speed) • Process temperature • Process Oxygen content
	Particulate matter (PM) Sulphur dioxide (SO_2) Nitrous oxide NOx) Carbon monoxide (CO)	As soon as stable operations have been achieved, then annually thereafter.	Stack sampling and third-party laboratory analyses

Source	Parameters monitored	Frequency	Description
		Frequency of this stack sampling will be reviewed based on performance.	
Diesel fuel used on the FLNG facility and support vessels	Sulfur content	As required (every delivery)	Delivery certificates Laboratory sampling
	Volume used	Monthly	Delivery certificates and storage tank volumes
Flaring emissions	Total gas flared GHG emissions Sulphur dioxide (SO_2) Nitrous oxide NOx) Carbon monoxide (CO)	On-line	Predictive Emissions Monitoring System from the following parameters measured online: • Fuel flow • Fuel quality
Amine treatment off gas vented	Total gas vented CO_2 emissions	On-line	Predictive Emissions Monitoring System from the following parameters measured online: • Feed Gas Composition • Feed Gas Flow • Treated Gas CO_2 content • Treated gas Flow • Amine treatment off gas vent Flow
Fugitive emissions	GHG emissions VOC emissions	Monthly	Predictive Emissions Monitoring System
Total Greenhouse Gas Emissions	GHG emissions	Monthly	Predictive Emissions Monitoring System

5.2.3. Marine Vessel Assurance

All marine vessels which are planned to be used on the Prelude FLNG Development are required to achieve “Positive Vetting” in accordance with the requirements specified in the HSSE & SP Control Framework – Transport Manual - Maritime Safety. The provisions of the Shell Australia Marine Vessels Assurance Control Procedures apply to all activities associated with the Prelude FLNG field area. They are assessed to be in compliance prior to mobilisation to the Prelude field. The Marine Vessel Assurance process ensures that the physical safeguards detailed in the EP are robust, including:

- Navigation Equipment and Aids
- Communication Equipment
- Dynamic Positioning System
- Lifting Equipment
- Emergency shut-down, alarm and lighting systems

5.2.4. Environmental Checks, Audits and Assurance

Shell Australia’s and contractor’s HSSE Plans make provisions for monitoring, audits and review. Annual HSSE Plans identify environmental audits and reviews that are to be conducted for the year. These audits and reviews include ISO14001 internal and external audits, contractor HSSE audit, waste management audit/review, gap analyses against HSSE Control Framework Manuals, and compliance audit against this EP. Annual internal environmental audit is planned for the Prelude FLNG facility. The frequency of the audit will be reviewed during the annual HSSE Planning.

Formal and documented HSE inspections (including environmental aspects) of the FLNG facility and associated vessels will be undertaken by Site Management, in conjunction with

the site HSSE Advisor where applicable. These formal inspections focus on the identification and rectification of site hazards and compliance with procedures. The worksite coordinator conducts documented walk-arounds of the worksite, or any specific area of the worksite, which they are responsible. Any hazards or areas of concern will be rectified immediately, where possible. Where a hazard cannot be rectified immediately, closeout is tracked and expedited by the worksite HSE Coordinator. Any specific worksite environmental issues identified during these inspections will be discussed with management and highlighted to supervisors to brief their teams during toolbox talks and shift handovers.

These regular checks and audits work to make sure that the specified controls are in place to manage environmental risks, and that they remain working, contribute to continually reducing the risks to ALARP.

5.2.5. Management and Review of Environment Plan

Once the hook-up and commissioning activities have been completed and steady state operation has been achieved, a review of the environmental performance against the EP is to be carried out on an annual basis. The results of this review will be incorporated into future operations as part of continuous improvement.

5.2.6. Reportable Incidents

NOPSEMA will be notified of all reportable incidents under Regulation 26 of the OPGGS (E) Regulation within 2 hours of the incident and in writing with 3 days. Under the OPGGS (E) Regulations, **Reportable Incidents** are defined as *'an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage'.* All environmental effects with a severity 3 or greater (i.e. moderate to massive) in the Shell Risk Assessment Matrix are considered Reportable Incidents. Based on the risk assessment (Table 4), four events are considered to be of moderate or higher consequence:

- Diesel spill resulting from a collision with another vessel;
- HFO spill due to rupture of storage tank of a product offtake tanker;
- Condensate spill due to rupture of storage tanks on the FLNG facility as a result of breach of the hull; and
- An uncontrolled hydrocarbon release from the wellhead similar to a well blow-out.

5.3. Oil Pollution Emergency Plan

The Prelude Oil Pollution Emergency Plan (OPEP) supports the Prelude activities in the Permit Area WA-44-L and sets out Shell and Contractor responsibilities and response actions in the unlikely event of an oil spill during these operations. The OPEP and associated plans and procedures will be tested prior to and during Prelude FLNG operations, to make all personnel aware of their responsibilities in the OPEP.

Marine pollution response is based on a graduated or tiered scale of response whereby the amount of resources mobilised for a response and the agency in control may vary according to the scale and location of the incident, allowing escalation and de-escalation of the response.

Shell has a number of formal arrangements in place to access external assistance if required. These include:

- Australian Marine Oil Spill Centre (AMOSC) resources;
- Australian Maritime Safety Authority (AMSA) has access to resources under the National Plan;

- Shell's AMOSC managed shared Broome Stockpile;
- Mutual Aid arrangements (industry support from other participating petroleum companies);
- Oil Spill Response Ltd (OSRL); and
- Shell Global Response Support Network (GRSN).

The responsibility for an oil spill is dependent on location and spill origin. The National Plan for Maritime Environmental Emergencies (National Plan) 2014 sets out the divisions of responsibility for an oil spill response (see Table 13).

Table 13: Control Agency Assignments for the Prelude FLNG Activities

Jurisdictional Boundary	Spill Source	Jurisdictional Authority	Control Agency		
			Level 1	Level 2	Level 3
Commonwealth Waters	Shell Offshore Petroleum Facility (e.g. Prelude FLNG)	NOPSEMA	Shell	Shell	Shell
	Vessel	AMSA	AMSA	AMSA	AMSA
WA State Waters (3nm from baseline; Inc. Browse Island)	Shell Offshore Petroleum Facility	Department of Transport (DoT)	Shell	DoT*	DoT*

(*) In accordance with Westplan MOP: In the event of a Level 2/3 oil spill incident resulting from an Offshore Petroleum activity in Commonwealth waters that impacts State waters, the role of Controlling Agency will be performed by DoT for response activities in State waters. In such instances a DoT liaison officer should be requested to be mobilised to the Shell IMT as soon as possible.

The Shell spill response organisation is structured in line with the internationally recognised ICS system. The response organisation that will operate for a spill response is scalable suited to the nature and scale of the incident.

The key teams that make the emergency management team up are the Incident Management Team (IMT) and the Emergency Response Team (ERT). The following figure outlines the IMT and ERT organisations which are scalable to the nature and scale of the response i.e. one person can take on multiple roles where circumstances permit. The mobilisation of the ERT is at the directive of the OIM or delegate. The mobilisation of the IMT will occur by the Facility Incident Commander (IC) contacting the on-duty EIM who will then mobilise the IMT as the situation warrants.

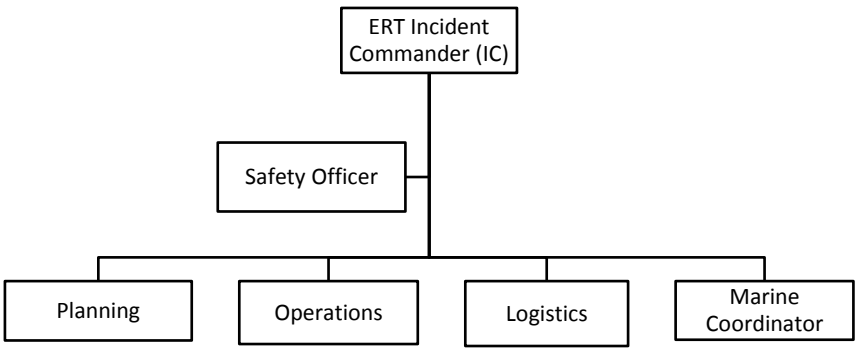

Figure 7: Emergency Response (ERT) Structure

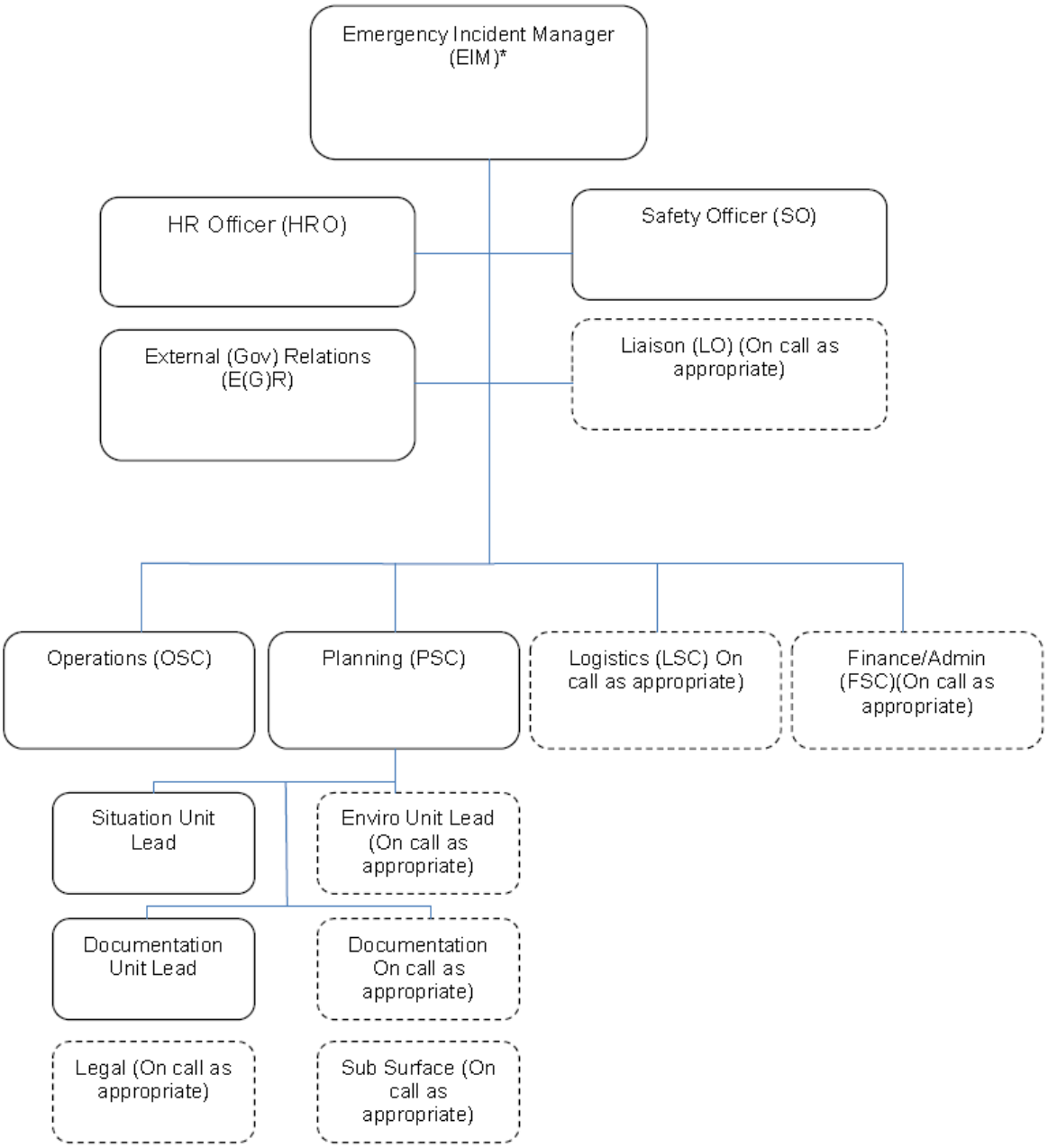

Figure 8: Incident Management Team (IMT) Structure

5.3.1.Response Actions

Should an oil spill incident occur, Shell will immediately follow the vessel's or FLNG facility's procedures to protect human life, equipment and reduce the risk of fire or explosion. This may involve cutting off supply to the spillage, containing spill on deck if safe to do so and implementing vessel's Shipboard Oil Pollution Emergency Plan (SOPEP). NOPSEMA and other relevant authorities such as AMSA, Department of Fisheries, Department of Transport and Department of the Environment will be notified, if and as required.

For spills extending beyond the initial actions, an Incident Action Plan (IAP) will be developed at the time of a spill, appropriate to the nature, size and scale of the activity and utilising the appropriate response strategies. The pre-spill planning assessment of the

applicability of each response strategy, including the Net Environmental Benefit Assessment (NEBA), will be revisited and updated if required based on the actual characteristics of the spill at hand.

The strategic NEBA was developed based on the risk evaluation, ALARP and acceptability assessments for all the emergency events outlined within the Prelude FLNG EP. This strategic NEBA forms the basis for the Initial (first strike) Actions outlined within the OPEP.

The approach described above, informed by priorities of protection and the NEBA procedure, defines the response strategies for the spill response considered, that will deliver a net environmental benefit.

The response strategies available to Shell Australia for the Prelude FLNG facility worst case spill scenarios include:

- **Monitor and Evaluate**; which is applicable for all spill events. NEBA will always support the monitor and evaluate strategy.
- **Natural Recovery**; Natural Recovery is planned for all spill scenarios except HFO spill. This is a complimentary response to Monitor and Evaluate, which is crucial in detemrining the effectiveness of natural recovery. Oil spill modelling indicates that surface spills at the Prelude location are expected to remain offshore, away from sensitive marine resources. Condensate spills have a low probability of reaching sensitive marine resources and as such monitoring and evaluating is crucial for informing decisions around complementary response strategy implementation.
- **Chemical dispersant (surface)**; only recommended for HFO spill, after an appropriate NEBA is completed and AMSA IC (as Control Agency) approval is obtained prior to dispersant application.
- **Contain and Recover**; only relevant for level 2 or 3 HFO spill, after an appropriate NEBA demonstrates benefit in use.
- **Shore-line Clean up**; requires DoT approval. Preparations for shoreline response would be made as soon as predictions indicate a possible shoreline impact. The tactics to clean up shorelines include Shoreline Assessement; Natural Recovery; Manual and mechanical removal; Washing, flooding and flushing; and sediment reworking and surf washing.
- **Oiled Wildlife**; for spills at Prelude, oiled wildlife is not expected given the low density of birds and reptiles in the area. However, if reported or predicted to be impacts, an oiled wildlife response will be initiated.
- **Oil Spill Monitoring;** in the event of a level 2 or level 3 spill, the oil spill monitoring plan will be enacted.

The implementation of response strategies will be subject to their ability to be executed safely and effectively. Constraints on the execution of response strategies applicable on the day may include but not be limited to; season, time of day, weather conditions, actual properties of the oil and seasons, safety and compliance with SOLAS 1974.

5.3.2. Testing the OPEP

Exercises are critical to ensuring there is an appropriate level of response readiness and they are an important part of continually managing the risks associated with an oil spill to ALARP levels. The Prelude OPEP will be tested prior to activity commencement and annually during the operate phase, to make all personnel aware of their personal responsibilities in these plans. An annual emergency exercise and drill schedule will be in

place recognising not every element will be tested every year. Elements to be tested shall include:

- An annual oil spill exercise during the operations phase to test communications and functionality of the OPEP.
- Staff ability to deploy spill response equipment
- Interface between ERT and IMT.
- Logistics functioning and capacity against that described within the OPEP
- Implementation of relevant OSMP sections
- Oil spill monitoring and evaluation tactics

5.3.3. Operational and Scientific Monitoring Plan

Shell has developed the Oil Spill Monitoring Plan (OSMP) to provide the situational awareness for use in planning or executing the spill response and to determine the ecological consequences of Level 2 and 3 spills to enable environmental impact and recovery to be measured. Details on personnel resources and mobilisation times are outlined within the OSMP.

As a summary of the objectives:

- The Operational Monitoring Guidelines (OMs) are undertaken during the course of the spill and include any physical, chemical and biological assessments which may guide operational decisions such as selecting the appropriate response and mitigation methods and / or to determine when to terminate a response activity. The design of the OMs requires judgements to be made about scope, methods, data inputs and outputs that are specific to the individual spill incident, balancing the operational needs of the response with the logistical and time constraints of gathering and processing information. There is a need for information to be collected and processed rapidly to suit response needs, with a lower level of sampling and accuracy needed than for scientific purposes.
- The Scientific Monitoring Guidelines (SMs) can extend well beyond the termination of response operations. Scientific monitoring has objectives relating to attributing cause-effect interactions of the spill or associated response with changes to the surrounding environment. The SMs will be conducted on a wider study area, extending beyond the spill footprint, will be more systematic and quantitative and aim to account for natural or sampling variation.

6. Stakeholder Consultation

As operator and on behalf of the Prelude FLNG Joint Venture, Shell Australia has consulted with “relevant persons” in accordance with the NOPSEMA Guidelines for Assessment of Environment Plans: Deciding on Consultation Requirements (N-04750-GL1629) under the OPGGS (Environment) Regulations 2009 for the Prelude FLNG Environment Plan (EP).

In addition, since the field was discovered in 2007, the Prelude FLNG Project has had a proactive Stakeholder Engagement Plan which includes ongoing liason with both “relevant persons” as described in the regulations as well as interested stakeholders including key local communities of interest, namely Broome and Darwin, Shell Australia has robust feedback mechanisms in place to gather claims or objections related to the Prelude Development .

To our best knowledge, Shell has ensured all Relevant Persons have been provided with sufficient information and had the opportunity to raise any objections or claims.

In the preparation of this EP Shell has addressed objections and claims raised by relevant persons with our assessment of merits of each claim or objection and our response, including revisions to the EP where necessary, as set out in Table 15.

6.1. Consultation Background

6.1.1. The Prelude FLNG Environment Plan Consultation

Consultation and stakeholder engagement on the proposed Prelude FLNG Project began when the gas field was first discovered in early 2007, and has continued since the Final Investment Decision (FID) was taken in May 2011. This included a thorough consultation process on the environmental impacts of the project for the Prelude Floating LNG Project Environmental Impact Statement. The project received environmental approval under the Environment Protection and Biodiversity Act 1999 on the 12th November 2010. Extensive consultation was also carried out to support the acceptance of the Prelude Drilling and Completions Environment Plan (2012) and the Prelude Subsea Installation Environment Plan (2014).

Preparation of consultation activities commenced in March 2015 using information and practices developed as part of the ongoing Prelude FLNG Stakeholder Engagement Plan.

The EP has been subject to two opportunities to modify and re-submit; therefore Shell’s consultation has been undertaken as follows:

- March 2015: Consultation commenced for the initial submission of the EP
- Jan 2016: First submission
- June 2016: Consultation updated as per feedback from NOPSEMA
- June 2016: Second submission
- August 2016: Consultation undertaken in line with the NOPSEMA Guidelines for Assessment of Environment Plans: Deciding on Consultation Requirements (N-04750-GL1629)
- October 2016: Third submission

6.1.2. Ongoing Consultation

Upon acceptance of this EP, Shell will uphold its commitments to ensuring relevant persons continue to be consulted throughout the five year duration of this plan.

Shell has determined that the most effective way to manage ongoing consultation in line with this EP will be undertaking consultation around the key project milestones of installation, commissioning, start up and operations. Consultations will be tailored to the specific functions, interests or activities of the relevant persons.

Timing will be set by progress vs key project milestones and an assessment will occur to ensure that all relevant persons are engaged appropriately.

Relevant persons themselves can and have identified their preferred ongoing engagements for Prelude. In such cases, that suggestion is considered and if appropriate, implemented.

These consultations will be planned, tracked and recorded as part of the Prelude FLNG Stakeholder Engagement Plan, and be subject to the half yearly (internal) review of that document.

Shell's internal 'management of change' process will also ensure that any material changes to the activity scope will trigger engagement with those who may be impacted.

Shell will ensure any claims or objections, or feedback, from the ongoing consultation is processed as per Shell's internal claims process, and any identified risks will be managed to ALARP levels as required in this EP.

The Prelude FLNG Environment Plan Relevant Persons and Consultation Process is set out in Table 14.

Table 14: Prelude FLNG Environment Plan Relevant Persons and Consultation Process

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
Commonwealth Government	Australian Border Force	Maintains the integrity of Australia's international borders including customs and immigration Marine user / operator	• Letter via email • Follow up phone call	• Consult pre - installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Commonwealth Government	Department of Agriculture and Water Resources	Biosecurity regulator and responsible for Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974.	• Letter via email, with specific information on biosecurity and MOU • Follow up phone call	• Consult Prelude Biosecurity Management Plan. • Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Commonwealth	Australian	The RAN Australian	• Letter via email	• Consult pre –

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
Government	Hydrographic Service (Department of Defence)	Hydrographic Service is the Commonwealth Government agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating in Australian waters. Issue notice to mariners and update nautical charts. Operate under the Australian Navigation Act 2012.	• Follow up phone call	installation and commissioning. AHS have requested 3 -4 weeks' notice for any mariners notices to be issued. • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Commonwealth Government	Department of Foreign Affairs and Trade (DFAT)	International relations with governments and other organisations. Specifically, DFAT will have functions relating to oil spills in international waters or foreign countries jurisdictions.	• Letter via email, tailored to confirm protocols in case of oil spill (including key contact) • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Commonwealth Government	Department of the Environment and Energy	Administers the EPBC Act. Main functions are associated with providing oiled wildlife advice in commonwealth waters during an Oil spill.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Commonwealth Government	Federal Department of Communications	Manage the installation of telecommunications infrastructure. In relation to the EP, their role is to avoid issues associated with subsea physical presence and disturbance issues as it relates to existing or planned subsea	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Relevant change of EP

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
		telecommunications infrastructure.		
Commonwealth Government	Federal Member for Kimberley	Representing the federal seat of Kimberley. Interest in potential Environmental Impacts (oil spills).	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Environmental NGOs	Australian Conservation Foundation	Environmental NGO, with interests in pollution (CO2), natural and cultural heritage in the Kimberley and environmental policy.	• Letter via post • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Environmental NGOs	Australian Marine Conservation Society	Environmental NGO with interests in threatened species, climate change and marine parks	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Environmental NGOs	Conservation Council	Environmental NGO seeking protection and conservation of all nature in Western Australia. Particular interests in potential oil spills around Browse Island.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Environmental NGOs	Greenpeace	Environmental NGO with interest in biodiversity.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
				up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Environmental NGOs	WWF	Environmental NGO with interests in the biodiversity of the Kimberley.	• Letter via post • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Commonwealth Fishing Association	Peak body representing the collective rights, responsibilities and interests of a diverse commercial fishing industry in Commonwealth regulated fisheries.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Kimberley Professional Fisherman's Association	Represent professional fishers in the Kimberley region. Represent the Northern Dermersal Scalefish Fishery.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Mackeral Managed Fishery	Activities exist in or in close proximity to Prelude. Near-surface trawling activities near coastal areas primarily.	Letter via post	• Consult pre – installation and commissioning • Consult pre-start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g.

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
				Maintenance turnaround etc.)
Fisheries	North Coast Shark Fishery	Activities exist in or in close proximity to Prelude. Primarily use demersal gillnets and longlines.	Letter via post	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of scope • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	North West Slope Trawl Fishery	Activities exist in or in close proximity to Prelude. Bottom trawl.	Letter via post	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Northern Demersal Scalefish Fishery NB: Represented by the Kimberly Professional Fisherman's Association.	Activities exist in close proximity to Prelude, as confirmed by DoF and WAFIC. Primarily trap based fishery.	• Letter via post • Letter via email to Kimberley Professional Fisherman's Association • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Pearl Oyster Fishery NB: Represented by the PPA	Activities exist in or in close proximity to Prelude. Bottom drifting divers from Lacepede Islands south to Exmouth.	• Letter via email • Follow up phone call to PPA	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Pearl Producers Association (PPA) NB: Represents the Pearl Oyster	Peak industry representative body for the Pinctada maxima pearling industry licensees in	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
	Fishery.	Western Australia.		• Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	RecFish	Recfishwest is the peak body representing 740,000 recreational fishers in Western Australia.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	Southern Bluefin Tuna Fishery	The Southern Bluefin Tuna Fishery covers the entire sea area around Australia, out to 200 nm from the coast. Pelagic long line and purse seine fishing gear is used.	Letter via post	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	WAFIC	Peak commercial fishing industry body to representing commercial fishers in WA.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Fisheries	West Coast Deep Sea Crustacean Fishery	Activities exist in or in close proximity to Prelude. Baited pots >150m, mostly between 500m - 800m.	Letter via post	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
				turnaround etc.)
Fisheries	Western Tuna & Billfish Fishery	Activities exist in or in close proximity to Prelude. Near surface longline and minor line gear used.	Letter via post	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Government Agency	Australian Fishery Management Authority (AFMA)	The Australian Fisheries Management Authority (AFMA) is the Australian Government agency responsible for the efficient management and sustainable use of Commonwealth fish resources, in particular, Section 7 of the Fisheries Administration Act 1991.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
Government Agency	Australian Marine Safety Authority (AMSA) including AMSA RCC.	The Australian Maritime Safety Authority (AMSA) is a statutory authority established under the Australian Maritime Safety Authority Act 1990 (the AMSA Act). AMSA are the responsible authority for the National Plan for maritime environmental emergencies. This power is provided under the AMSA act 1990 Regulator for the Australian Navigation Act 2012 and Protection of the Sea Act 1983.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.) • Send NOPSEMA-accepted OPEP
Marine Organisations	AIMS	Shell's current operational and scientific monitoring program contractor.	• Letter via email, tailored to include OSMP • Follow up phone	• Consult pre – installation and commissioning • Consult pre- start

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
			call	up • Relevant change of EP
Marine Organisations	Australian Marine Oil Spill Centre (AMOSC)	The Australian Marine Oil Spill Centre Pty Ltd (AMOSC) operates the Australian oil industry's major oil spill response facility.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.) • Send NOPSEMA accepted OPEP
State Government	Department of Environment Regulation (WA)	Administers Section 72 EP act, reporting of Environmental Pollution. Have a role in the environmental management of WA state jurisdiction.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP
State Government	Department of Mines and Petroleum (DMP)	DMP is the responsible regulatory agency for offshore petroleum activities in Western Australian state territory and waters with reference to DMP Environment Division as the lead Western Australian agency for environmental issues associated with Petroleum exploration or production Noted that DMP is also the Joint Authority with the DMP Executive Director Petroleum Division being the Delegate of the State Member for the Joint Authority with responsibilities under the OPGGS Act.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
State Government	NT Department of Fisheries	Management of biosecurity risks to NT fisheries.	• Letter via email • Follow up phone call	• Consult Prelude Biosecurity Management Plan • Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
State Government	State Member for Kimberley	Representing the State seat of Kimberley, with an interest in potential Environmental impacts including oil spills.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP
State Government	WA Department of Fisheries (DOF)	The Department of Fisheries' cover policy development, licensing and legislation related to the State's commercial and recreational fisheries, pearling, aquaculture, the aquatic charter industry, customary fishing and protection of aquatic ecosystems, including safeguarding our aquatic biosecurity. They administer the Fish Resources Management Act 1984.	• Letter via email, tailored to close out open objections and claims. • Offer meeting face to face • Follow up phone call	• Consult Prelude Biosecurity Management Plan • Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Major offshore activities (e.g. Maintenance turnaround etc.)
State Government	WA Department of Parks and Wildlife (DPAW)	The Department of Parks and Wildlife manage wildlife within state land and waters and WA state marine parks and reserves. They are the lead	Consultation undertaken for submission 1&2 considered sufficient	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP

Category	Relevant Persons	Functions, Interests or Activities relevant to the EP	Consultation Approach	Ongoing Consultation
		agency for oiled wildlife response during an oil spill. These powers are defined under the Wildlife Conservation Act 1950 and the Animal Welfare Act 2002.		
State Government	WA Department of Transport (DOT)	DOT are responsible for managing oil spills in state waters under the Emergency Management Act 2005.	• Letter via email • Follow up phone call	• Consult pre – installation and commissioning • Consult pre- start up • Annual during operations • Relevant change of EP • Send NOPSEMA accepted OPEP

Table 15: Consultation carried out specifically for the Prelude Installation, HUC and Operations

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
Commonwealth Government					
1. Australian Border Force	Consultation has been ongoing with the Australian Border Force for many years in relation to immigration and customs requirements for the project. Correspondence on 23 August 2016 and 07 September 2016	07 September 2016 -phone call advised not to expect a response from the Department.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
2. Australian Hydrographic Service	Correspondence on 23 August 2016, 13 September 2016 and 15 September 2016	23 August 2016 - email confirming receipt of letter. 15 September 2016 - phone call to confirm receipt of letter. Requested that notification to AHS for a notice to mariner's be issued 3 weeks prior to mobilisation. Informed that notices are generally only issued for activities lasting more than 2 weeks. A permanent notice is issued for facility locations and subsea infrastructure. Also requested to update contact details to datacentre@hydro.gov.au. Confirmed that AHS operate primarily under the Australian Navigation Act.	Further consultation to occur 3-4 weeks out from sail away to allow notice to mariners to be issued in time.	Confirmed Shell or contractors will notify of activities planned to occur no more than 3-4 weeks out from activity commencement.	Sufficient information supplied. Appropriate consultation completed. Further consultation to occur 3-4 weeks out from sail away. See Section 6.1.2.
3. Department of Agriculture and Water Resources (DAWR)	Consultation with DAWR (previously AQIS and DAFF) has been ongoing for many years in relation to quarantine and biosecurity requirements for Prelude. Correspondence on 22 August 2016 and 06 September 2016	06 September 2016 - email received confirming receipt of letter and that it had been forwarded to the correct department.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed. Shell will continue to engage with DAWR on biosecurity requirements including the development of the biosecurity management plan.
4. Department of the Environment and Energy (DEE)	Correspondence on 23 August 2016 and 23 September 2016	23 September 2016 - phone call to confirm receipt of letter. Department rep indicated that email couldn't be located but will locate it and will follow up if necessary.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
5. Department of Foreign Affairs and Trade (DFAT)	Correspondence on 23 August 2016 , 29 August 2016 and 30 August 2016 and 03 October 2016	Based on previous engagements, DFAT have requested that Shell contact the Directorate of Indonesia / East Timor in the event of an oil spill that would affect Indonesian territorial waters. 30 August 2016 - email with confirmation that DFAT would engage in any whole-of-government response to an oil spill or similar incident coordinated by the Department of Industry, Innovation and Science, should the need to do so ever arise. However, in addition to the usual contact protocols, they would appreciate early advice of events that are likely to engage such a response.	Early advice requested for events that cross international boundaries	Shell confirmed the notification details and triggers requested would be included within the OPEP.	Sufficient information supplied. Appropriate consultation completed. DFAT contact noted in OPEP.

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		Contact details supplied.			Contact details updated.
6. Federal Department of Communications (DOC)	Correspondence on 23 August 2016 , 23 September 2016 28 September 2016 , 29 September 2016 , 04 October 2016 and 10 October 2016	23 September 2016 - phone call to confirm receipt of letter. Dept. confirmed policy responsibility for submarine telecommunication cables. Will aim to respond by Tuesday 27 September 2016. Further information requested on scope of project, work coordinates, timeframes and a map with coordinates. 28 September 2016 – phone call requesting further information on: • Whereabouts of the facility • Associated infrastructure Contact details supplied. 04 October 2016 – email to confirm that a formal letter would be sent within the week. 10 October 2016 – email confirming that installation of Prelude FLNG will be in the vicinity of submarine cable infrastructure not within a declared submarine cable protection zone. Suggest that Shell continue to consult with relevant submarine cable operators, specifically Nextgen Networks, to ensure that activities taking place during installation, commissioning and operations of the facility do not impact on or inadvertently damage submarine cables and infrastructure. Suggest that Shell determine whether any submarine cables exist along the route it plans to tow the Prelude FLNG facility. Confirmed that the Australian Communications and Media Authority has been consulted in preparing this response.	No objections or claims to date.	n/a	29 September 2016 – email sent with requested information. Contact details updated. 10 October email Acknowledging receipt of information. Details provided to relevant project team focal points to ensure activities take into account the information provided by the Department. Sufficient information supplied. Appropriate consultation completed.
7. Federal Member for Kimberley	Correspondence on 23 August 2016 07 September 2016 and 12 September 2016	07 September 2016 - phone call confirming receipt of letter. 12 September 2016 - email confirming receipt of letter. No further information required.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
Environmental NGO's					
8. Australian Conservation Foundation	Correspondence on 23 August 2016 by post and 20 September 2016	20 September 2016 - phone call confirmed the right person to speak to. Resent the letter via email.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
9. Australian Marine Conservation Society	Correspondence on 23 August 2016 and 20 September 2016	20 September 2016 - phone call to confirming receipt of letter. Resent the letter via email. Advised that they were unlikely to respond.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
10. Conservation Council	Correspondence on 23 August 2016, 01 September 2016 06 September 2016 07 September 2016 04 October 2016, and 05 October 2016	23 August 2016 - email from Conservation Council requesting a copy of the Greenhouse Gas and Energy Management Plan and the approval status of the plan. 01 September 2016 – email to Conservation Council on			Sufficient information supplied. Appropriate consultation completed.

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		the approval status of the plan. 04 October 2016 – email with feedback that the Greenhouse Gas Management Plan is a condition of the Ministerial approval for the project under the EPBC Act. As such it should be a publicly available document.	Has the GHG Management Plan required as a condition of environmental approval been signed off by the Minister? If not why not? If so please provide a copy of the approved plan.	In late 2012 Shell was advised by the Department of Environment at that time, that the condition requiring us to submit a Greenhouse Gas Management Plan had been revoked. Once the Environment Plan has been accepted by NOPSEMA, Shell will share the Environment Plan summary with the Conservation Council.	
11. Greenpeace	Correspondence on 22 August 2016 and 20 September 2016	20 September 2016 - phone call to confirm receipt of letter. Greenpeace will follow up internally and advise should they have any concerns.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
12. WWF	Correspondence on 23 August 2016 by post and 20 September 2016	20 September 2016 - phone call to confirm receipt of the letter. Confirmed contact details.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
Fisheries					
13. Commonwealth Fishing Association	Correspondence on 23 August 2015 06 September 2016 and 29 September 2016	06 September 2016 - phone call to confirm receipt of letter. The Commonwealth Fishing Association confirmed that they would send a reply email recommending consultation with regional fishing bodies and fishers. 29 September 2016 – phone call to follow up. Resent the letter via email.	No claims or objections to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
14. Kimberley Professional Fisherman's Association (KPFA)	Correspondence on 22 August 2016 07 September 2016 and 14 September 2016	07 September 2016 - phone call to confirm receipt of letter. Resent the letter via email. It was reconfirmed that we had the correct point of contact for the Kimberley Professional Fisherman's Association. 14 September 2016 - phone call to confirm receipt of letter. It was confirmed that the letter had been forwarded to other fishers in the Northern Demersal fishing area. If they have any concerns they will contact Shell directly.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
15. Northern Demersal Scalefish Fishery	Correspondence on 23 August 2016 by post	No response to date. See above Kimberley Professional Fisherman's Association who have forwarded on communications to those fishers in the area.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
16. Mackeral Managed Fishery	Correspondence on 23 August 2016 by post	No response to date.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
17. North Coast Shark Fishery	Correspondence on 23 August 2016 by post	No response to date.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
18. North West Slope Trawlery	Correspondence on 23 August 2016 by post	No response to date.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
19. Pearl Producers Association (PPA)	Correspondence on 23 August 2016 and 06 September 2016	06 September 2016 - phone call confirming receipt of the letter. They will review and let us know if they have any issues or concerns. Confirmed that the association remains the contact for the Pearl Oyster Fishery commercial fishers at the moment.	No objections or claims to date.	n/a	Sufficient information supplied. Fair consultation completed.
20. RecFish West	Correspondence on 23 August 2016 and 06 September 2016	06 September 2016 - phone call to confirm receipt of the letter. Confirmed if they do not respond they do not have any claims or objections.	No objections or claims to date.	n/a	Sufficient information supplied. Fair consultation completed.
21. Southern Bluefin Tuna Fishery	Correspondence on 23 August 2016 by post	No response to date.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
22. WAFIC	Correspondence on 30 November 2015, 21 March 2016, 23 March 2016 18 May 2016 face to face meeting, 30 May 2016, 23 August 2016 04 September 2016 and 05 September 2016	23 March 2016 - email received requesting further information on Prelude exclusion zones and location of subsea infrastructure. 23 March 2016 – email providing further detail on location specifics, project timing and safety zone, including associated maps with coordinates. 18 May 2016 - face to face meeting with WAFIC and Shell. WAFIC interested in safety zones, Prelude footprint and construction activities in the area. Confirmed the Northern Demersal Fishery operate in the area, and that the Northern Demersal fishery may want to understand liquid discharges. Explained the project takes up a small part of this large fishery, and the subsea equipment will attract fish which could have a potential impact on the commercial operators 04 September 2016 - email confirming receipt of letter, also requesting confirmation that the letter had been sent to commercial fishers operating in the area for their information.	• Northern Demersal fishery may want to understand liquid discharges. • Subsea equipment will attract fish. Advised to contact the commercial fishers operating in the area.	Shell engaged with Department of Fisheries and Northern Demersal Fishery on Fish Aggregation Devices, safety zones and liquid discharges. Shell letter from August 23 2016 states “Although limited pelagic species associated with the FLNG and the safety zone will be afforded some protection from fishing activity, the benefit to fish ecology is considered to be of slight significance due to the temporary nature of the residency of fish near the FLNG and the total larger area for pelagic species in the region (compared to the area of the safety zone around the FLNG).” Confirmed that commercial fishers had been contacted by post.	Assessment of merits of objections and claims about any adverse impact have been closed. Sufficient information provided. Appropiate consultation completed

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
23. West Coast Deep Sea Fishery	Correspondence on 23 August 2016 by post	No response to date.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
24. Western Tuna & Billfish Fishery	Correspondence on 23 August 2016 by post	No response to date.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
Government Agencies					
25. Australian Marine Safety Authority (AMSA)	Consultation has been ongoing with AMSA for many years for compliance with the Navigation Act and POTS Act, including during tow. In addition, AMSA have been engaged regarding their responsibilities and interface with Shell under the National Plan and AMSA Act 1990. Correspondence on 23 August 2016 07 September 2016 and 22 September 2016	07 September 2016 - phone call confirming the following: • AMSA RCC are the search and rescue branch of AMSA in addition to the marine pollution report line. Shell don't have search and rescue as a part of the EP scope, therefore this aspect is not relevant to the EP. • Shell will make reference to contacting the marine pollution reporting line as required for ship related incidents or incidents where AMSA assistance is requested through the signed MOU. • Confirmed AMSA approval for use of dispersant will be required on the day of a response for incidents where it is the Control Agency. In addition, all other first strike responses should be implemented ASAP (e.g. contain and recover), not requiring AMSA approval on the day. • Shell has liaised closely with AMSA on various other environment related matters including the POTS Act and the Navigation Act relating to Prelude activities already. 22 September 2016 – email response on dispersant consent clarification and noting that AMSA would expect low levels of efficacy with Heavy Fuel Oil.	• Confirmed AMSA approval for use of dispersant will be required on the day of a response for incidents where it is the Control Agency. In addition, all other first strike responses should be implemented ASAP (e.g. contain and recover), not requiring AMSA approval on the day. • Send the accepted OPEP to AMSA Marine Pollution.	Shell confirmed it would reflect all the requirements (claims) outlined within the OPEP.	Sufficient information supplied. Appropiate consultation completed. The accepted OPEP will be sent to AMSA Marine Pollution.
26. Australian Fishery Management Authority (AFMA)	Correspondence on 22 August 2016, 13 September 2016 and 04 October 2016	13 September 2016 - phone call confirming receipt of the letter which has been forwarded to the 'petroleum department'.	No objections or claims to date.	n/a	Sufficient information supplied. Appropriate consultation completed.
Marine Organisations					
27. AIMS	Correspondence on 23 August 2016, 25 August 2016, 26 August 2016, 07 September 2016 and 08 September 2016	25 August 2016 - email received with comments on the draft Shell OSMP • Seeking confirmation that the full text version matches the AIMS Deployment Manual and requesting an updated version if any changes had been made. • Requested to check the contract end date to ensure it reflected February 2019 • Questioned if AIMS should be listed as an 'Independent Consultant or Research Organisation' or if Shell is the Implementation Agency.		• Shell updated the OSMP and provided a copy. • Contract end date modified to state 2019 • Updated to list AIMS as conducting response activities.	Sufficient information supplied. Appropriate consultation completed.

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		• Requested a final version of the OSMP once finalised. 08 September 2016 – email received asking if any significant changes had been made to affect AIMS response to an oil spill. Confirmed that AIMs would communicate expected changes to INPEX's response priorities, which will have a material impact on the deployment manual and the way AIMS responds to INPEX.		• All documents will be sent again once accepted by NOPSEMA • Confirmed the only changes were updates to reporting requirements and that no changes were made to the implementation of the monitoring programs themselves.	
28. Australian Marine Oil Spill Centre (AMOSC)	Correspondence on 23 August 2016 and 29 August 2016	29 August 2016 - email confirming they would like to see the finalised OPEPs as part of their preparedness.	Would like to see the finalised OPEP.	The finalised OPEP will be sent to AMOSC.	Sufficient information supplied. Appropriate consultation completed.
State Government					
29. Department of Environment Regulation WA (DER)	Correspondence on 08 September 2015, 09 September 2015, 22 August 2016 07 September 2016)and 13 September 2016	09 September 2015 - email received confirming receipt of factsheet. Advised that comment had not been made regarding EIA nor environmental regulation requirements as the project is in Commonwealth waters hence will be regulated by NOPSEMA and the Commonwealth Environmental Protection agency. Asked to note the requirement to advise or notify DER of impacts in state areas per S 72 of the Environmental Protection Act for oil spills but also waste discharged (drilling fluids, chemicals etc.) to the environment (such as to sea or state land environment). Asked to refer to the EP Act for definitions of Environment, Waste, Discharge, Emission and Pollution. The reporting requirement is not required for Commonwealth areas however if Shell Australia oil spill or operation and production waste enter state waters, Shell Australia is obliged per S72 to notify DER.	• Asked to note the requirement to advise or notify DER in state areas per S 72 of the Environmental Protection Act for oil spills but also waste discharged (drilling fluids, chemicals etc.) to the environment (such as to sea or state land environment).	• Shell Australia incorporated this requirement into the notification procedures and operationalisation of the OPEP.	Sufficient information supplied. Appropriate consultation completed. OPEP updated to reflect DER request.
30. Department of Mines and Petroleum (DMP)	Correspondence on 23 August 2016, 02 September 2016, 06 September 2016 07 September 2016 08 September 2016 09 September 2016 08 September 2016 13 September 2016 21 September 2016 face to face 28 September 2016 29 September 2016 03 October 2016 04 October 2016 05 October 2016 and 10 October 2016	02 September 2016 - email from DMP requesting further information on the receiving environment, zones of potential impact from a spill, details on the activity of amine treatment off gas venting and details on discharges to the sea. 06 September 2016 – phone call to DMP confirming receipt of email. Most interested in zones of impact, particularly for offshore islands e.g. Browse Island. Confirmed that Commonwealth notifications normally come through in a prescribed format. 07 September 2016 –phone call with DMP • Confirmed a face to face meeting would be scheduled. • Confirmed that DMP expects to be consulted as a	• Concerns raised that high CO2 concentrations emitted from Prelude could impact state waters through acidification of the marine environment. DMP requested evidence to review regarding this perceived risk. • Stated DMP were the approval authority for dispersant use in commonwealth waters where it could enter state waters. • DMP requested notification of any oil spill which could have impacts within state waters.	• Shell provided DMP evidence demonstrating CO2 ocean acidification would not be a risk • Shell agreed to include DMP notification of spills which could potentially enter state waters within the OPEP. • Shell confirmed it would follow DoT Dispersant Consent Framework for use of dispersant within commonwealth waters.	

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		relevant person and that they manage offshore state waters and expects to be consulted on impacts to those. They play a role advising Govt. Departments on offshore projects and impacts. • Shell stated that only a MAE (Level 2 or 3 oils spill) would impact State waters • DOT would be response agency for State • DMP advised DOT would liaise with them in this advice • DMP has functions and interests in any petroleum activity in Commonwealth waters which could impact the State (including state waters). • Agreed that full draft EP would be provided with relevant sections per DMPs flagged interests highlighted 21 September 2016 – face to face meeting Shell gave project overview and current status, briefed DMP on oil spill scenarios including modelling results. Specifically discussed AGRU emissions and CO2 emissions and oil spill response arrangements and associated government agency interfaces. Further information requested to demonstrate no impacts from CO2 emissions occur within state waters. 04 October 2016 - acknowledging receipt of emails on 8 September 2016, 28 September 2016 and 29 September 2016, and with feedback on information provided. 05 October 2016 – responded to DMP's requests for updating DMP's function in the EP, additional information relating to the impact of gas venting dispersion, and incident reporting to DMP. 10 October 2016 – email from DMP confirming acceptance of Shell's responses to their requests.	• Request to update DMP's function to ensure it captures DMP's regulatory role and jurisdictions. Suggestion made on wording. • Request for more information relating to the impact of the amine treatment off gas venting dispersion on environmentally sensitive receptors in the surrounding ocean, islands and reefs. It does not appear that modelling on plume dispersion to the surrounding and marine environment (i.e. away from the FLNG process area and living quarters) has been investigated and given the length of the project (25 years) this may result in negative environmental impacts.	• Shell updated DMP's function as suggested (see Table 14). However, for the purposes of this EP, the joint authority and NOPTA are not considered relevant persons. • Shell have considered the claim raised by DMP with respect to acidification of state waters and impacts to sensitive receptors in state jurisdiction. Shell's conservative assessment of atmospheric emissions included modelling which strongly supported the basis there would be no impact on state receptors from the Prelude facilities CO2 emissions. The modelling as per supplementary information Shell sent, ambient air standards are met within 236m of the release point. In addition, the AERSCREEN model results showed all air contaminants reached ambient air limits within 1km. The AERSCREEN model is considered highly conservative and the amine treatment off gas vent plume is expected to behave the same, on the basis that the AERSCREEN model	Fair consultation completed. Assessment of merits of objections and claims about any adverse impact have been closed. DMP satisfied with information provided. Sufficient information provided.

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
				predicts the behaviour of the whole plume. Shell has done a literature review of localised ocean acidification and were unable to source any peer-reviewed studies of such occurrences. This supports our statement that to risk assess the impact of Prelude emissions on ocean acidification in isolation is difficult as the associated effects of CO2 emissions (which includes ocean acidification) are the cumulative effect of many sources, across the globe, and it is the cumulative effects that ultimately bring about climate change and ocean acidification.	
			• Request that incident reporting to DMP, as detailed in DMP's Consultation Guidance Note, is included in the EP and OPEP. Request that if a spill was to occur, DMP are notified of any potential dispersant use which is likely to impact on State waters.	• Shell has included DMP for incident reporting in the OPEP There are no other potential incidents which could impact state jurisdiction, apart from spills. If this were to change in future, Shell would be required to re-engage with DMP. Shell confirmed the OPEP has also been updated to include a DMP notification for potential dispersant use which is likely to impact on State waters.	Updated OPEP. Appropiate consultation completed.
31. NT Department of Fisheries	04 November 2015 10 November 2015 face to face 22 December 2015, 23 August 2016, 13 September 2016 and 23 September 2016	10 November 2015 - face to face meeting. Their main interest was biosecurity, principally mitigation measures against introduction of marine pests but also discussed anti fouling and cleaning of facility and vessels prior to entry to Australia waters. Noted that Biosecurity Act not proclaimed and may not be in effect until 2017 – biosecurity regulations still in early draft form. 22 December 2015 - email requesting a copy of the biofouling management plan. 13 September 2016 - phone call to confirm receipt of the letter. NT Fisheries confirmed that nothing in it 'jumped out'. The NT Department of Fisheries are aligned with the WA Department of Fisheries. Their main issue is biofouling – how will Shell manage and how we will clean the facility before departure?	• Confirmation of sufficient control measures against introduction of marine pests. • Biofouling – threat of invasive marine species entering NT jurisdiction. • Request to have a copy of the risk assessment and the Biosecurity Management Plan once produced.	• Biosecurity risks seen as very low given biosecurity management plans in place and location • Shell has provided the same information as provided to DOF (WA) to NT Fisheries, as well as draft Prelude FLNG Environment Plan Section 4.2.6. • Shell will share Biosecurity Management Plan once finalised.	The NT Departmenf of Fisheres are being consulted in the Biosecurity Management Plan and the Biofouling Management plan. Share Biosecurity Management Plan once finalised.

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		23 September 2016 – email to confirm that concerns are being addressed in the proposed actions for biofouling.			
32. State Member for Kimberley	Correspondence on 22 August 2016 and 07 September 2016	07 September 2016 - phone call to confirm receipt of letter. Suggested that a catch up meeting to brief MLA on Prelude generally be scheduled before year end 2016.	No objections or claims to date.	n/a	Sufficient information supplied. Update briefing on Prelude project be be arrranged. Appropriate consultation completed.
33. WA Department of Fisheries (DOF)	**Submission 1 & 2** Correspondence on 30 March 2015, 12 July 2015, 12 September 2015, 24 September 2015, 05 October 2015, 08 October 2015, 12 October 2015, 14 October 2015, face to face meeting 15 October 2015, 04 November 2015, 12 November 2015, 16 December 2015, 21 December 2015, 18 January 2016 Formal Letter, 11 February 2016 Formal Letter 03 March 2016, 17 March 2016, 08 April 2016, 15 April 2016	16 September 2015 – phone call, requesting the following information • Biosecurity risks ○ More information on how the biosecurity risks of the facility being towed in and installed are being managed ○ This information also for in-field vessels / support vessels for installation, commissioning and operations • Would like information on how marine pests will be dealt with in subsea scope, given marine pests attraction to mooring chains, flowlines, anchor piles • What products are the subsea infrastructure made out of? ○ Impact on Fisheries and Fish habitats ○ Will assess with regard to impact on fishing operations, given large, long life facility might impact commercial fishing operators ○ Interested in snagging risks and how these will be managed ○ Interested in impact on fish spawning zones? ○ Will consult with Fisheries stakeholders but emphasised we should • Oil spill risks and management ○ Interested in our OSCPs, potential impact on fisheries in the event of a spill • Water intake ○ Would like more information on nature of water intake risers and how environmental risks will be managed 15 October 2015 – face to face meeting with DoF, followed by an email on 19 October 2015 from DoF outlining requests arising from the meeting: • Seawater intake – size of filter/mesh and provide comment back to DoF • DoF requested Shell engage with NT Fisheries • Requested the copies of the Shell Australia Biosecurity Management Plan and the Prelude Biosecurity Management Plan • DoF requested Shell consult Northern Demersal			Overall Status: As the Department has raised a number of items that require ongoing, active consultation, in particular around Biosecurity and specifically relating to the Biosecurity Management Plan and the Biofouling Management Plan, Shell regards the consultation with the Department as open and ongoing. Shell has formally committed to the Department to actively consult in the development of the Biosecurity Management Plan and the Biofouling Management Plan and consultation in the development of both plans is ongoing. The Biosecurity Management Plan is required under the Biosecurity Act 2015 (Cwlth).

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		Scalefish fishers 07 December 2015 – phone conversation where DoF advised that they were keen to provide formal feedback but could not do so without Shell fulfilling the request for further information: the biosecurity manual and information on the water intake risers. 16 December 2015 - email from DoF acknowledging receipt of information provided and committing to a formal response in early 2016. 18 January 2016 – formal letter received from DoF **1. Consultation** The installation, commissioning and operational activities of the Prelude FLNG has the potential to affect fish populations and the operations of fishers who harvest these resources. Because of this potential impact, the Department requests that Shell Australia Pty Ltd consult with the Western Australian Fishing Industry Council (WAFIC), the Pearl Producers Association of WA, RecfishWest and individual licensed fishers regarding the overall proposal, including methods, and incorporate comments from this consultation in the EP summary.	**Consultation** The installation, commissioning and operational activities of the Prelude FLNG has the potential to affect fish populations and the operations of fishers who harvest these resources. Because of this potential impact, the Department requests that Shell Australia Pty Ltd consult with the Western Australian Fishing Industry Council (WAFIC), the Pearl Producers Association of WA, RecfishWest and individual licensed fishers regarding the overall proposal, including methods, and incorporate comments from this consultation in the EP summary.	**Consultation** As part of the Environment Plan consultation process and the Safety Zone application, Shell Australia consulted with WAFIC, the Pearl Producers Association of WA, Recfishwest and a number of individual licensed fishers. Shell Australia also attended a meeting with the Northern Demersal Fishers and WAFIC in November 2015. Shell Australia also sought further meetings with WAFIC and Northern Demersal Scalefish Fishers to discuss Prelude safety zone implications.	
		2. Fishing Activities in the area The Department advises that the following commercial fishing interests exist in, or in close proximity to, the areas associated with the proposed activities: Permit Area: WA-44-L Bioregion and Province: North Coast Bioregion, Timor Province Commercial Fishing Interests: Mackerel Managed Fishery; North Coast Shark Fishery; Pearl Oyster Fishery; West Coast Deep Sea Crustacean Managed Fishery Information provided by Shell Australia Pty Ltd on the 24/09/2015 stated that “the expected impact of the Prelude activities on fishing (both commercial and traditional) is expected to be slight to none because of low fishing effort in the region”. The Department disagrees with this statement and requests Shell Australia Pty Ltd to consult directly with the Northern	**Fishing Activities in the Area** DoF disagree with Shell Australia’s statement that “the expected impact of the Prelude activities on fishing (both commercial and traditional) is expected to be slight to none because of the low fishing effort in the region”. Request that Shell consults directly with Northern Demersal Scalefish Fishers as they are actively fishing in the area and the large exclusions zones may directly impact their operations.	**Fishing Activities in the Area** Shell Australia accepted the Department of Fisheries position on the Northern Demersal Scalefish Managed Fishery and undertook further consultation with the Northern Demersal Scalefish Managed Fishery, with no issues raised. Shell sent DoF an excerpt of the Physical Presence impact and risk evaluation direct from the Environment Plan.	**Fishing Activities in Area** Sufficient Information provided. Appropiate consultation completed

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		Demersal Scalefish Fishers as they are actively fishing in the area and the large exclusion zones may directly impact their fishing operations. **3. Pollution Emergency Plans** In the event of an oil spill or discharge of any other pollutant into the environment, the Department requests that its spill response office is contacted by phone (0433 151 567) and by email (environment@fish.wa.gov.au) within 24 hours of Shell Australia Ltd reporting the incident to the appropriate authority. When developing the Pollution Emergency Plans (PEPs), the Department requests that Shell Australia Pty Ltd collects baseline marine data to compare against any post-spill monitoring to determine the nature and extent of any impacts. This data should be made available to the Department upon request. For further guidance, please see the Operational and Scientific Monitoring Programs advice statement produced by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Spawning grounds and nursery areas for key fish species are particularly vulnerable to the impacts of spills. The Department therefore requests the specific strategies are developed in the Environment Plan and/or PEPs to mitigate these risks. Our data indicates that the following key fish species may be spawning within the proposed area of activities: **Bioregion Key Fish Species within zone** / **Spawning / Aggregation times** North Coast Baldchin groper: September – February Blacktip Shark: November – February Crystal Crab: All year round Goldband snapper: January – April King George whiting: June – September Ranking Cod: August – October Red emperor: October – January Sandbar Shark: October – January Spangled emperor: September – December Spanish mackerel: August - November **4. Habitat and Fish Impacts** The proposed activity to install 16 anchor piles and mooring lines will permanently alter the benthic habitat, temporarily increase turbidity and mobilise sediments. Equipment that is left unburied can also cause ongoing erosion of the substrate and persistent turbidity. This can result in a direct loss of benthic organisms,	**Pollution Emergency Plans** The Department requested that in the event of an oil spill or discharge of any other pollutant into the environment, the Department's oil spill response office is contacted by phone and email within 24 hours of Shell Australia reporting the incident to the appropriate authority. When developing the Pollution Emergency Plans (PEPs), the Department requests that Shell Australia Pty Ltd collects baseline marine data to compare against any post-spill monitoring to determine the nature and extent of any impacts. Spawning grounds and nursery areas for key fish species are particularly vulnerable to their impacts of spills. DoF request that specific strategies are developed in the Environment Plan and OPEP to mitigate these risks. Key fish species were outlined in letter dated 18 January 2016. **Habitat and Fishing Impacts** The proposed activity to install 16 anchor piles and mooring lines will permanently alter the benthic habitat, temporarily increase turbidity and mobilise sediments. Equipment that is left unburied can also cause ongoing erosion of the substrate and persistent turbidity. This can	**Pollution Emergency Plans** Shell Australia has included DoF as a stakeholder in our OPEP and intends to meet all regulatory requirements around oil spills. Consistent with regulatory requirements to notify Regulators and in accordance with the OPEP Shell Australia will notify DoF as soon as possible (within 24 hours) of a level 2 or 3 oil spill. Since the start of the Prelude project Environmental Impact Assessment process in 2009, Shell Australia, along with other operators in the Browse basin, have collected significant amounts of baseline data covering most facets of environmental studies. Where data is not publically available, Shell Australia has access to other operator's baseline data through various mechanisms including the Industry and Government Environmental Meta-database program. Shell Australia provided DoF with the existing baseline metadata available. Shell Australia will update the Environment description in the EP to include the key fish species within the Prelude zone of potential impact. Shell Australia has carried out an impact evaluation on spawning grounds for those fish species listed. Shell Australia has a Prelude Oil Spill Emergency Plan (OPEP) which outlines all the mitigations for reducing impacts to key environmental sensitivities, including spawning grounds, for key fish species. **Habitat and Fishing Impacts** Shell sent DoF an excerpt of the disturbance to seabed impact and risk evaluation direct from the Environment Plan (Section 4.2.4), which includes an assessment of benthic impacts.	**Pollution Emergency Plans** Sufficient Information provided. Appropiate consultation completed **Habitat and Fishing Impacts** Sufficient information provided. Appropiate consultation completed.

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		including shellfish. The FLNG is likely to be in-situ for a long period of time, and may become a Fish Aggregation Device (FAD). This may affect the distribution of fish stocks in the area which can in turn have economic impacts on the commercial fishing industry. The Department therefore requests that this issue is discussed directly with potentially affected fishers.	result in a direct loss of benthic organisms, including shellfish. The FLNG is likely to be in-situ for a long period of time, and may become a Fish Aggregation Device (FAD). This may affect the distribution of fish stocks in the area which can in turn have economic impacts on the commercial fishing industry. The Department therefore requests that this issue is discussed directly with potentially affected fishers.	Some pelagic fish species will be attracted to the FLNG facility and subsea equipment and will not be available to fishing effort within the safety zone. However, most of the pelagic species found in the region will not become permanent residents under the FLNG facility. Studies on other offshore oil and gas facilities worldwide indicate that generally, Fish Aggregation Devices work for only a relatively short period of time as fish shoals and fish will only be present for a number of days or weeks. Although limited pelagic species associated with the FLNG and the safety zone will be afforded some protection from fishing activity, the benefit to fish ecology is considered to be of slight significance due to the temporary nature of the residency of fish near the FLNG and the total larger area for pelagic species in the region (compared to the area of the safety zone around the FLNG). The Prelude FLNG Environmental Impact Statement (EIS) indicated that most demersal species are unlikely to occur within the project area as these species are strongly associated with shallow environments such as near shore shelf systems. Examination of information on existing commercial activities directly in or adjacent to the project area indicates very low commercial fishing effort (less than 100 kg per 100 sq.km. per year). The issue of the potential of the Prelude FLNG facility to function as a Fish Aggregation Device has been raised directly with commercial fishers in the area, who have received in the same terms as our letter to DoF on 24 August 2016, with a specific discussion on this issue. As noted in our response of February 2016, our assessment is that given the limited presence of the commercial stocks in the area and the scale of the potential refuge zone, we would not expect there to be a significant impact on existing commercial fisheries.	
		5. Water Intake Shell Australia Pty Ltd state that “on the screens of the Water Intake Risers (WIR: Inlet velocity is 0.2 m/s at the inlet screen which is not considered a risk for fish to be ‘sucked’ in. The diameter at the inlet screen	**Water Intake** The Department requests that strategies are employed to minimize the impact of Water Intake Risers on smaller fish, eggs and larvae.	**Water Intake** Wastewater discharges from the FLNG facility are designed to comply with the ANZECC guidelines in terms of the overall effect on the receiving water	**Water Intake** Sufficient information provided. Appropiate consultation completed.

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		openings is 50mm. As detailed in the Environment Plan, screens are installed at the inlet of the cooling water risers to prevent the ingress of large marine organisms and debris into the system, and hence impacts to larger organisms are avoided". The Department requests that strategies are employed to minimize the impact of WIR on smaller fish, eggs and larvae. The Department also requests that all discharges from the FLNG comply within Australian and New Zealand Guidelines for Fresh and Marine Water Quality. **6. Biosecurity** Biofouling is thought to be the vector for approximately 70 per cent of marine pests introduced into Australia. Vessels can acquire marine pests in coastal waters but also as a result of vessel-to-vessel transfer far from shore. The Western Australian government, and not the Australian government, manages biofouling via the Fish Resources Management Act 1994 and associated regulations. The Department therefore again requests that Shell Australia Pty Ltd provides copies of their biosecurity manual and Prelude Biosecurity Management Plan and undertakes detailed consultation with us on the FLNG project prior to commencing operations. It is further requested that any biofouling management plan refers to the use of the Department's ne biofouling risk assessment tool – Vessel Check (https://vesselcheck.fish.wa.gov.au) and that recommended actions to manage vessel movements to a LOW / ACCEPTABLE risk rating prior to entry into WA waters are undertaken. Alternatively, the Department requests the active use of a biofouling management plan and record book that meet all requirements under Appendix 2 of the current edition of the International Maritime Organisation's Guidelines for the Control and Management of Ships Biofouling to Minimise the Transfer of Invasive Aquatic Species. It is also requested that the prelude Biosecurity Management Plan describes how Shell Australia Pty Ltd intends to ensure all vessels remain at a low risk after arrival in WA state waters, perhaps via follow-up marine pest inspections. Undertaking these actions will minimize the likelihood that Shell Australia Pty Ltd commits offences under the FRMA regarding the transferal of live non-endemic or noxious fish into or within WA. The Department requests that suspected detections in WA waters of any marine pests to be reported within 24 hours by email (biosecurity@fish.wa.gov.au) or	The Department also requests that all discharges from the FLNG comply within Australian and New Zealand Guidelines for Fresh and Marine Water Quality. **Biosecurity** • DoF request that any biofouling management plan refers to the use of the Departments new biofouling assessment tool – vessel check – and that recommended actions to manage vessel movements to a low/acceptable risk rating prior to entry into WA waters are undertaken. Alternatively, the Department requests the active use of a biofouling management plan and record book that meet all requirements under Appendix 2 of the current edition of the International Maritime Organisation's Guidelines for the Control and Management of Ships Biofouling to Minimise the Transfer of Invasive Aquatic Species. • It is requested that the Prelude Biosecurity Management Plan describes how Shell Australia intends to ensure all vessels remain at a low risk after arrival in WA state waters. • The Department requests that suspected detections in WA waters of any marine pests to be reported within 24 hours by email (biosecurity@fish.wa.gov.au) or telephone (FishWatch: tel 1800 815 507). This includes any organism listed in the Western Australian Prevention List for Introduced Marine Pests and any other non-endemic organism that demonstrates invasive characteristics. • Please ensure the requests above are forwarded directly to all vessel operators associated with the project.	quality. The water intake is at about 170m depth. Smaller fish, eggs and larvae are usually found in the sunlit zone of the water column and not in deeper water. Seafloor communities in deeper waters are generally less abundant and diverse. Surveys and studies within the project area indicate low abundance of plankton at the intake depth and fish larval assemblage composition was primarily dominated by neritic species, which have little or no commercial value. **Biosecurity** Shell Australia will consult with the Department of Fisheries for the development and implementation of the Prelude Biosecurity Management Plan. This will be the primary document used to manage biosecurity risks for Prelude and associated transits to WA and NT ports. As noted above Shell will engage with DoF during the development of the Prelude Biosecurity Management Plan and will further discuss the above points as part of this engagement (see Section 4.2.6). A draft copy of the Prelude Biosecurity Management Plan will be provided during this consultation as it is further developed in line with new Biosecurity Management Act (Cwlth), with reference to the Fish Resources Management Act 1994 as appropriate. Shell commits to ensuring all vessels remain at a low risk after arrival in WA state waters. The key control measure(s) Shell will adopt will be outlined in the development of the Prelude Biosecurity Management Plan. Shell will incorporate this requirement into the Prelude Biosecurity Management Plan. All vessels operated by Prelude will be operating under the Biosecurity Management Plan.	**Biosecurity** As noted above the Department has raised a number of items that require ongoing, active consultation, including the Biosecurity Management Plan and Biofouling Management Plan, Shell regards the consultation with the Department as open and ongoing

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		telephone (FishWatch: tel: 1800 815 507). This includes any organism listed in the Western Australian Prevention List for Introduced Marine Pests (see http://www.fish.wa.gov.au/Documents/biosecurity/epa_introduced_marine_pests.pdf) and any other non-endemic organism that demonstrates invasive characteristics. Please ensure the requests above are forwarded directly to all vessel operators associated with the project. **7. Expectation / Implementation** The Department requests a written response that addresses all potential impacts to fisheries, fish and fish habitats described in this letter and strategies that Shell Australia Pty Ltd will implement to mitigate or minimize these impacts. The Department also requests that impacts, as described above, and any objections or claims raised by stakeholders including those raised by the Department, are included in the EP submission. 03 March 2016 – email received from DoF acknowledging consultation undertaken and contesting that the project area lies outside the boundary of the Northern Demersal Scalefish Managed Fishery. 08 April 2016 – email requesting early engagement on biofouling. 02 September 2016 - phone call to confirm receipt of letter. 08 September 2016 - email received from DoF formally requesting an extension to comment and confirming that a face to face meeting is not required. 11 October 2016 – formal letter response to detailed letter on EP.	**Expectations / Implementation** The Department also requests that impacts, as described above, and any objections or claims raised by stakeholders including those raised by the Department, are included in the EP submission.	**Expectation / Implementation** A formal written response was provided to Dof on 11 February 2016 and 26 August 2016. Shell confirms that all objections or claims raised by DoF will be included in the EP submission.	
	Submission 3 Correspondence on 24 August 2016 , 26 August 2016 , 29 August 2016 , 31 August 2016 , 02 September 2016), 08 September 2016, 13 September 2016, 23 September 2016, 27 September 2016, 03 October 2016, 04 October 2016, 10 October 2016 Letter from DoF, and 11 October 2016 Response to DoF	**1. Consultation** The installation, commissioning and operational activities of the Prelude FLNG has the potential to affect fish populations and the operations of fishers who harvest these resources. Because of this potential impact, the Department requests that Shell Australia Pty Ltd (Shell) undertake ongoing consultation on this proposal with the Western Australian Fishing Industry Council (WAFIC), the Pearl Producers Association of WA, Recfishwest, and licensed fishers within affected fisheries. The Department requests that this	**Consultation** The Department requests that Shell Australia Pty Ltd (Shell) undertake ongoing consultation on this proposal with the Western Australian Fishing Industry Council (WAFIC), the Pearl Producers Association of WA, Recfishwest, and licensed fishers within affected fisheries. The Department requests that this consultation has a particular focus on exclusion zones, and that comments resulting from this consultation are incorporated into the EP submission.	**Consultation** Shell has consulted with the mentioned relevant persons. In response to prior feedback from the Department, this included a detailed letter prepared especially for the fishing sector that included details on the Prelude FLNG safety zones and the potential that Prelude may function as Fish Aggregation Device. To date, none of the stakeholders groups have raised any	.

<table>
<tr><th>Relevant Persons</th><th>Consultation Undertaken</th><th>Summary of Response</th><th>Stakeholder Objections and Claims</th><th>Assessment of Objections and Claims</th><th>Status</th></tr>
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<td>consultation has a particular focus on exclusion zones, and that comments resulting from this consultation are incorporated into the EP submission.

2. Fishing activities in the area

The Department advises that the following commercial fishing interests exist in, or in close proximity to, the areas associated with the proposed activities:

<table>
<tr><th>Permit Area</th><th>Bioregion and Province</th><th>Commercial Fishing Interests</th></tr>
<tr><td>WA-44-L</td><td>North Coast Bioregion, Timor Province</td><td>Mackerel Managed Fishery

North Coast Shark Fishery

Northern Demersal Scalefish Managed Fishery

Pearl Oyster Fishery

West Coast Deep Sea Crustacean Managed Fishery</td></tr>
</table>
</td>
<td>Fishing activities in the area

The Department advises that the listed commercial fishing interests exist in, or in close proximity to, the areas associated with the proposed activities and therefore are relevant persons who require consultation.</td>
<td>concerns with the potential impact of the exclusion zone on fishing effort or with Prelude FLNG in general.

Shell will engage with the relevant persons mentioned by DoF prior to project milestones (pre-installation and commissioning, pre-start-up, before relevant changes to the scope or the EP and before any major offshore activities, e.g. maintenance turnaround) and on an ongoing basis (annual during operations). Shell will continue to provide specific information on the project Safety Zones as part of these consultations.

Fishing activities in the area
Section 3.5 of the EP acknowledges these commercial fisheries are permitted to operate near to, or in, WA 44L. Each fishery has been identified as a relevant person by Shell and consulted as a relevant person in the preparation of this EP.</td>
<td></td>
</tr>
</table>

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		3. Fish Aggregation Devices (FAD) Information provided by Shell Australia Pty Ltd on the 24 August 2016 stated that "The Prelude FLNG Environmental Impact Statement indicated that most demersal species are unlikely to occur within the project area as these species are strongly associated with shallow environments such as near shore shelf systems". The Department disagrees with this statement. In Western Australia, inshore demersal species occur in water depths between 20 and 250 metres, and offshore demersal species occur in water depths from the 250 metre isobath to the edge of the Exclusive Economic Zone (200 nautical miles)1. As previously advised, the Northern Demersal Scalefish fishers actively operate in the waters in the North Coast bioregion of Western Australia and around the petroleum permit W-44-L, and therefore require engagement as a key stakeholder for this project. **4. FLNG** The Department understands that the FLNG is likely to be in situ for approximately 25 years and will result in long-term changes to the environment for fish and fishers. To better manage these changes, Shell has already proposed mitigations for many of the potential risks imposed by the FLNG and supporting vessels, including liquid discharges, atmospheric emissions, waste management and emergency events. The Department requests that the following additional measures are incorporated into the final EP to manage potential impacts to fish and fishers: • A prohibition on fishing from the FLNG and support vessels for the life of the project; • A long-term monitoring project sampling fish and fish habitat at regular intervals (of not more than one year between sampling), the data from which would be made available to the Department upon request; • Long-term, ongoing communication with affected fishers; and • A range of biosecurity measures, as outlined below.	**Fish Aggregation Devices (FAD)** The Department disagrees with the statement in the Prelude EIS regarding demersal species and advises that the Northern Demersal Scalefish fishers actively operate in the waters in the North Coast bioregion of Western Australia and around the petroleum permit W-44-L, and therefore require engagement as a key stakeholder for this project. **FLNG** The Department requests that the following additional measures are incorporated into the final EP to manage potential impacts to fish and fishers: • A prohibition on fishing from the FLNG and support vessels for the life of the project; • A long-term monitoring project sampling fish and fish habitat at regular intervals (of not more than one year between sampling), the data from which would be made available to the Department upon request;	**Fish Aggregation Devices** Shell will amend its assessment of demersal species to reflect the Department's advice above. Shell agrees that the Northern Demersal Fishers area operates around WA-44-L, and as such, has regarded this group as 'relevant person' and has consulted with them as part of this EP. To date, the group (as represented by KPFA) has not raised any concerns with Prelude. Shell confirms that, consistent with the OPGGS Act, fishing is prohibited at all times from the Prelude FLNG. Shell also does not allow fishing from all support vessels. Shell has an Applied Research Program (ARP) study that is intended to gather representative baseline marine environmental scientific data in support of spill preparedness. This ARP includes a study to evaluate the potential of commercial catch data as a means to detect or quantify the effect of hydrocarbons on target populations in the Northern Demersal Scalefish Fishery and to quantify levels of biochemical markers and indicators of hydrocarbon exposure for key commercial species, providing an improved understanding of spatial variation in these indicators and	

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				increased ability to detect point source impacts. This study is ongoing and results can be made available to the Department. In addition, if triggered by an oil spill incident (Level2/3 incident), a scientific monitoring survey is required to determine, quantify and monitor the scale of impacts (temporally, spatially, ecologically) of the oil spill and response methods on fisheries and aquaculture resources and subsequent recovery of key processes (i.e. breeding).In preparation of the EP, Shell has not identified any likely net environmental negative impacts on fish and fish habitats. As demonstrated in the Prelude FLNG EP, the impacts of our activities to fish and fish habitats are acceptable and ALARP.In receiving feedback from relevant persons to date, Shell Australia has not identified any potential conflict with extant fishing effort. As such, Shell does not accept the requirement to conduct long-term monitoring or sampling of fish and fish habitat at regular intervals.	
			• Long-term, ongoing communication with affected fishers; and	As per the response above, Shell will engage with the relevant persons identified by the Department prior to project milestones (pre-installation and commissioning, pre-start-up, before relevant changes to the scope or the EP and before any major offshore activities, e.g. maintenance turnaround etc.) and on an ongoing basis (annual during operations). Shell will continue to provide specifics information on the project Safety Zones.	
		5. Biosecurity Biosecurity is a key risk for this project because of the international origins of the installation, and the high value of the receiving waters which will come into contact with Prelude and its support vessels. Biosecurity risks should be managed under both federal and state legislation, including management of ballast water under the federal Biosecurity Act 2015,	**Biosecurity** The Department requests that Shell manages adverse biosecurity impacts appropriately through the development of a biosecurity management plan that covers key issues of biofouling and ballast water management, and ongoing consultation on biosecurity concerns.	**Biosecurity** As per previous discussions with the Department, Shell is currently developing the Prelude Biosecurity Management Plan, to meet the requirements of the Biosecurity Act 2015 and relevant State law where applicable. Consistent with prior commitments, Shell will consult the	

Relevant Persons	Consultation Undertaken	Summary of Response	Stakeholder Objections and Claims	Assessment of Objections and Claims	Status
		and management of biofouling to satisfy state and territory legislation requirements under the WA Fish Resources Management Act 1994. This includes the prevention of marine pests being introduced into the state under the Fish Resources Management Regulations 1995. To date, Shell has provided limited information on how biosecurity risks will be managed. Therefore, the Department requests that Shell manages adverse biosecurity impacts appropriately through the development of a biosecurity management plan that covers key issues of biofouling and ballast water management, and ongoing consultation on biosecurity concerns. **1. Biofouling** The Department requests that Shell develops an approved biofouling management plan prior to movement of the Prelude vessel. The Department requests that this management plan is developed in consultation with a recognised biofouling inspector and the Department. At a minimum, and to prevent the introduction, establishment and spread of marine pests via biofouling, Prelude and associated vessels will need to be cleaned to a very high standard as soon as possible prior to departure from overseas or interstate. This will remove existing biofouling and minimise new settlement. Post cleaning, these vessels will then need to be inspected for, and cleared of, marine pests. Following arrival of Prelude and associated vessels into Australian waters, follow-up inspections will be required to ensure that no marine pests have been transported. These inspections should be carried out 75 days after departure from overseas or interstate ports. Discussions should be held with the Department regarding follow-up inspections and whether ongoing marine pest monitoring is required. Additional information on what is expected by the Department for Prelude and all of its support vessels, including use of the Vessel Check tool, can be found online at: http://www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-BiosecurityVessels-And-Ports/PagesVessel-Check.aspx.	**Biofouling** The Department requests that Shell develops an approved biofouling management plan prior to movement of the Prelude vessel. The Department requests that this management plan is developed in consultation with a recognised biofouling inspector and the Department. At a minimum, and to prevent the introduction, establishment and spread of marine pests via biofouling, Prelude and associated vessels will need to be cleaned to a very high standard as soon as possible prior to departure from overseas or interstate. This will remove existing biofouling and minimise new settlement. Post cleaning, these vessels will then need to be inspected for, and cleared of, marine pests. Following arrival of Prelude and associated vessels into Australian waters, follow-up inspections will be required to ensure that no marine pests have been transported. These inspections should be carried out 75 days after departure from overseas or interstate ports. Discussions should be held with the Department regarding follow-up inspections and whether ongoing marine pest monitoring is required.	Department in the development of this plan. **Biofouling** As per Section 5.2.6 of the EP, for the Prelude FLNG facility, a Biofouling Management Plan will be developed to address the risk of transporting IMS from the shipyard in Geoje, South Korea. The Biosecurity (and Biofouling) Management Plan is being developed with Biofouling Solutions, lead by Ashley Coutts who is a recognised biofouling inspector. Shell will consult with the Department and DAWR on the Plan in the near future. A request for consultation on the plans will be sent to the Department separately. N.B. In the development of the Biofouling Management Plan, Shell and Biofouling Solutions is using the list of 82 “Noxious Fish” released under Schedule 5 of the Fish Resources Management Regulations 1995 as basis of the risk assessment. The Biofouling Management Plan will include details on biofouling removal in the shipyard to as low as reasonably practicable and in compliance with the Biosecurity Act 2015. Prior to departure from the yard, another inspection will be conducted by BFS to validate any biofouling removal activities, and to document that the FLNG can be considered low risk with respect to hull	

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				biofouling. The inspection report can be made available to the Department if requested. All associated project vessels that enter state waters will comply with the Biosecurity Act 2015 and State biosecurity requirements, including any required inspections to assist in ensuring that no “noxious fish” is brought into the state waters. Any vessels entering the Prelude field will also apply the principles of ballast water management that are contained in the Australian Ballast Water Management Requirements of the Biosecurity Act 2015. Any further inspections or ongoing marine pest monitoring will be discussed during consultation on the Biosecurity Management Plan.	
		Ballast water Ballast water management will be managed under the federal Biosecurity Act 2015, including any approved arrangements. Vessels travelling to and from Prelude will need to comply with this, and any future arrangements, which may include management of ballast water for movements between domestic ports. Ongoing consultation For all biosecurity issues, the Department requests that Shell formalises an agreed protocol for ongoing consultation with the Department during the implementation phase of the activity.	**Ballast water** Ballast water management will be managed under the federal Biosecurity Act 2015, including any approved arrangements. Vessels travelling to and from Prelude will need to comply with this, and any future arrangements, which may include management of ballast water for movements between domestic ports. **Ongoing consultation** For all biosecurity issues, the Department requests that Shell formalises an agreed protocol for ongoing consultation with the Department during the implementation phase of the activity.	**Ballast Water** Before reaching Australian waters, ballast water exchange will take place in open water, that is, at sea with clean open ocean water as per the IMO guidelines (International Convention for the Control and Management of Ship’s Ballast Water and Sediments 2004). These guidelines require ballast exchange to take place in open ocean water, typically 200 nautical miles from the nearest land and in water depths >200m deep. Shell will consult with the Department on the development of the Prelude Biosecurity Management Plan (a separate request will be sent to the Department). In addition, as part of our ongoing consultation which is covered in the EP, Shell will consult with the Department pre-installation and commissioning, pre-start-up, annually during operations, prior to any relevant	

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				changes to EP or scope, and before any major offshore activities, e.g. maintenance turnaround.	
		6. **Expectation/Implementation** The advice below is valid for a period of six months from the date this letter is signed. The Department's previous advice provided 18 January 2016 is also valid for a further six months from the date this letter is signed. If the proposed activities commence within this six month period, this advice will be valid for the duration of the Environment Plan (EP). If, however, the proposed activities do not commence within six months, the Department requires Shell to initiate further consultation on this proposal a minimum of three months prior to the commencement date. The Department requests a written response that addresses all potential impacts to fisheries, fish and fish habitats described in this letter and strategies that Shell will implement to mitigate or minimise these impacts. The Department also requests that all impacts, as described above, and any objections or claims raised by stakeholders, including those raised by the Department, are included in the EP submission. Should we have any further queries regarding your response we will notify you at this time. Please contact the Department on (08) 9482 7333 should you have any queries regarding the above advice.	**Expectation/Implementation** If the proposed activities commence within this six month period, this advice will be valid for the duration of the Environment Plan (EP). If, however, the proposed activities do not commence within six months, the Department requires Shell to initiate further consultation on this proposal a minimum of three months prior to the commencement date. The Department requests a written response that addresses all potential impacts to fisheries, fish and fish habitats described in this letter and strategies that Shell will implement to mitigate or minimise these impacts. The Department also requests that all impacts, as described above, and any objections or claims raised by stakeholders, including those raised by the Department, are included in the EP submission.	Shell has noted the date of validity and consistent with the commitments outlined in the EP will engage with the Department in these circumstances. Shell provided a formal written response on **11 October 2016.** The impacts raised in the correspondence have been included in the EP.	
34. WA Department of Parks and Wildlife (DPAW)	Correspondence on 09 September 2015, 22 December 2015, 02 May 2016, 30 May 2016, 28 July 2016 and 05 September 2016	09 September 2015 – phone call with DPAW interested in whether potential impacts would impact marine conservation areas for State or areas important to wildlife. In particular: • What baseline survey work we have done in areas of impact of project • Independent response capability for oiled wildlife, to standards consistent with State plan which has been developed with AMOSC 22 December 2015 – phone call with DPAW requesting more detail on Oil Spill Response Plan and our process for the prioritisation of response arrangements when there could be competing personal safety and environmental considerations.	• Concern was raised around the potential to not respond to oiled wildlife on the basis of high VOC's from a spill. Particularly around Browse Island. • Concern of what would be done to respond to birds oiled at sea in commonwealth waters returning to Browse Island to roost. • Expect that Browse Island spill response pre-planning would be done to overcome potential issues with a response at that location.	• VOC's would not likely be a response concern around Browse Island. • The oiled wildlife response would be implemented if oiled birds were to potentially occur during a spill. This could include oiled wildlife response from Browse Island. • Confirmed that pre-spill planning will occur for Browse Island.	DPAW satisfied with information provided. Assessment of merits of objections and claims about any adverse impact have been closed. Sufficient information provided within a reasonable period.

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		28 July 2016 - phone call: • Confirming they are happy for operators to refer to implementation the WA Oiled Wildlife Response Plan and relevant regional response plan (once approved). Noting the Kimberly Region Oiled Wildlife Response Plan was not approved (only drafted) at the time of this engagement. • Concern was raised around the potential to not respond to oiled wildlife on the basis of high VOC's from a spill. Particularly around Browse Island. • Concern of what would be done to respond to birds oiled at sea in commonwealth waters returning to say Browse Island to roost. • Expressed interest in their marine science division receiving applied research program (ARP) data outcomes once completed. • Expect that Browse Island spill response pre-planning would be done to overcome potential issues with a response at that location. • Recognised that this is not in their jurisdiction however expressed an interest in feedback during operations around if any actual observed impacts from Prelude lighting are observed. The main concern here was only with migrating passerine and shorebirds, not seabirds. This is on the assumption that shorebirds and passerines could become caught in a 'light trap' and this could affect their survivability during a long migration. DPAW indicated although this issue is not observed on the NW shelf it could be unique to the Browse Basin. • DPAW appreciate periodic follow-ups in future.			DPAW's interest in the research program is outside of their identified function. This was provided as information only. Lighting is outside of DPAW's identified function – to be provided as information only.
35. WA Department of Transport (DOT)	Correspondence on 23 August 2016 07 September 2016 and 22 September 2016	07 September 2016 - phone call to confirm receipt of letter. 22 September 2016 – phone call to discuss DoT's Dispersant Use Consent Framework.	No objections or claims to date.	n/a	The accepted OPEP will be sent to DoT.

7. Details of titleholder and liaison person

Shell Australia Pty Ltd is the titleholder and operator for the Prelude FLNG Development. Contact details for Shell Australia are as follows:

Liaison person:
Lauren Gorton
Address: 562 Wellington Street, Perth 6000 WA
Tel.No.: +61 8 9338 6000
Email address: sda-preludeflng@shell.com

Should there be changes to the details of Shell's liaison person and titleholder of this EP, NOPSEMA shall be notified through email (submissions@nopsema.gov.au) and via written correspondence.