Pluto LNG – Sea Turtle Management Plan

August 2024

Revision 13

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1. Introduction

1.1 Purpose

Woodside Burrup Pty Ltd (Woodside) is the proponent of the Pluto Liquefied Natural Gas (LNG) facility (Pluto LNG). Woodside was granted State Ministerial approval for Pluto LNG under MS 757, as amended by MS 850. Commonwealth Approval was granted under Commonwealth Ministerial Approval – EPBC Reference: 2006/2968.

MS 757 was granted for two trains to a capacity of 12 million tonnes per annum (mtpa). Commencement of Train 1 operations began on 1 August 2013 in accordance with Operating Licence L8752/2013/1 (approved under Part V of the *Environmental Protection (EP) Act 1986*).

The existing Pluto LNG facility (known as Pluto Foundation) is currently a 4.9 mtpa loadable capacity single-train LNG plant processing gas from Pluto and Xena gas fields. As part of the proposed Pluto Expansion scope, Woodside intends to construct and operate a second LNG train (approximately 5 mtpa capacity) at Pluto LNG within the existing Foundation disturbance footprint.

This Sea Turtle Management Plan (STMP) focuses on managing potential impacts to sea turtles and marine mammals associated with Pluto LNG (both from Foundation and Expansion activities).

Specifically, this management plan:

- focuses on management actions and strategies associated with onshore, nearshore and offshore activities for Pluto Foundation and associated maintenance activities (e.g. in the event that maintenance dredging associated with Foundation Operations needs to occur);
- focuses on management actions and strategies associated with onshore activities for Pluto Expansion; and
- is aligned with the best-practice standards incorporated within the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020).

The plan supersedes the previous regulator-approved STMPs including:

- the construction and commissioning phase STMP approved in 2008 as part of the Pluto LNG (i.e. Train 1 Construction) ministerial requirements (WA Statement No. 757 and Commonwealth EPBC Approval Decision:2006/2968).

1.2 Scope

State and Commonwealth primary environmental approvals for Pluto LNG were finalised in late 2007 (Ministerial Statement 757 and EPBC Approval 2006/2968) and provided approval for the following key project components:

- an offshore platform, associated subsea infrastructure and a gas trunkline;
- an onshore LNG plant and storage facilities; and
- a jetty, associated navigation channel and berthing pocket.

On 1 July 2019, changes were approved under Section 45C of the *Environment Protection Act*, to the Pluto Liquefied Natural Gas Development (Site B Option) as approved under MS 757 (Pluto LNG Gas Development: Application under section 45C of the Environmental Protection Act 1986 (WA) – Pluto Expansion).

The onshore and nearshore components of Pluto Foundation and the proposed Pluto Expansion are shown within **Figure 1**.

Figure 1 - Pluto LNG Site A and B on the Burrup Peninsula

A variety of activities associated with Pluto Foundation and the proposed Pluto Expansion may have an impact upon sea turtles. Activities included in the scope of this plan are:

- routine operation and maintenance activities;
- potential maintenance dredging works and associated dredge spoil disposal both within and outside of Mermaid Sound;
- operation of LNG and condensate storage and export facilities on Site A (predominantly from lighting);
- vessel movement from operations and maintenance; and
- activities associated with the Pluto Expansion scope, which includes Pluto Train 2.

Further information on all environmental aspects of Pluto LNG is contained within the Public Environment Report/Public Environmental Review (Woodside 2006).

The Scarborough project proposes to transport feed gas to Pluto LNG for processing; however, Scarborough infrastructure (including a new trunkline and shore-crossing to Pluto LNG) and capital dredging associated with the Scarborough project will be subject to separate State and Commonwealth referrals and environmental approval mechanisms. This activity is out of scope of this STMP.

1.3 Description of Operator

Woodside Burrup Pty Ltd (WBPL), a wholly owned subsidiary of Woodside Energy Ltd, is the operator of Pluto LNG and associated infrastructure for Pluto LNG.

Woodside Energy Ltd (Woodside) is the pioneer of the LNG industry in Australia and the largest Australian natural gas producer. Construction of a second gas processing train has commenced at Pluto LNG. Pluto Train 2 would process gas from the Scarborough gas resource and have a capacity of about 5 million tonnes per annum (Mtpa) (100% project).

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

1.4 Management Plan Requirements and Objectives

1.4.1 State Approval Requirements

The minimum requirements for this plan are summarised in the framework STMP, contained within the Pluto LNG Public Environment Report/Public Environmental Review (Woodside 2006 - Appendix Table G-1). The plan also fulfils the requirements, as approved under the provisions of the *Environmental Protection Act 1986* (WA) (Ministerial Statement No. 757).

This STMP is required under Condition 9-1 of MS 757:

> *'Prior to the commencement of works and in consultation with the Department of Environment and Conservation, the proponent shall prepare a Turtle Management Plan to the requirements of the Minister for the Environment.'*

The objectives of this plan as per Condition 9-1 MS 757 are to:

- *'provide a management framework to enable Woodside and its contractors to detect and mitigate as necessary any impact upon marine turtles or marine mammals from the project; and*
- *identify darkness strategies to reduce as far as practicable lights or light glow interfering with nesting female turtles and hatchlings.'*

Table 1 describes how the requirements of MS 757 are met.

Table 1 - Concordance Table with MS 757

MS 757 Condition	Condition Requirement	Section
9-1(1)	Identify project-related stressors (causes of environmental impacts) and potential consequences for marine turtles or marine mammals (including impacts of noise, vibration, light overspill and glow, vessel strike, and changes to coastal processes).	Section 3
9-1(2)	Identify and demonstrate the effectiveness of the proposed management measures to mitigate project-related impacts and consequences for marine turtles.	Section 2, Section 4
9-3	The proponent shall make the Turtle Management Plan required by condition 9-1 publicly available in a manner approved by the CEO.	Section 1.7
9-4	The proponent shall review the Turtle Management Plan required by condition 9-1 annually to the requirements of the Minister for the Environment.	Section 6.4

9-5	The proponent shall report any mortality of marine turtles or other threatened or specially protected marine fauna to the Department of Environment and Conservation within 24 hours following observation.	Section 6.1

1.4.2 Commonwealth Approval Requirements

This STMP is required under Condition 6 of EPBC Referral: 2006/2968. **Table 2** describes how the requirements of EPBC Referral: 2006/2968 are met.

Table 2 - Concordance Table with EPBC Reference 2006/2968

EPBC Condition	Condition Requirement	Section
6a)	Minimising the area of disturbance during site design, particularly with regard to habitat for listed sea turtles and marine mammals.	N/A (only applicable during Foundation Project Construction Phase)
6b)	The induction of contractors prior to work in such matters such as sensitive habitat locations.	Section 6.3
6c)	Maintaining sightings of sea turtles and marine mammals and reporting of any incidents that occur in disposal operations that result in injury or mortality of marine mammals or sea turtles to the Department.	Section 3
6d)	Minimising light emissions onto the beach to the west of Site A and onto the water from the standalone jetty, including such measures as reducing light spill, during construction and operations.	Section 4
6e)	Monitoring of the beach at Holden Point for turtle nesting up to and including construction and reporting this information to the Department.	Section 2, Section 5, Section 6.1

It should also be acknowledged that advice from the Environmental Protection Authority (EPA) during the Project's ministerial appeals determination stated that it is unlikely the project will result in significant impacts on sea turtles, which are highly mobile creatures able to avoid operational activities and areas of turbidity and are capable of temporarily relocating to less disturbed areas for foraging and breeding (Office of the Appeals Convenor 2007b).

The contents of the STMP shall be reviewed on an annual basis and revised to include:

- Annual results of the sea turtle monitoring program;
- Changes to project scopes, where sea turtle impacts have not already been accounted for; and/or
- Consideration of advances in best practice management of lighting impacts on sea turtles.

1.5 Relevant Legislation

Sea Turtles are protected under both Western Australian and Commonwealth environmental legislation. **Table 3** summarises the relevant legislation for this STMP.

Table 3 - Legislation Relevant to the STMP

Legislation	Legislation Summary	Relevance to the STMP
Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)	The primary Commonwealth legislation for the protection and management of Matters of National Environmental Significance.	• The loggerhead turtle (*Caretta caretta*) and olive ridley turtle (*Lepidochelys olivacea)* are listed as endangered. • The leatherback turtle (*Dermochelys coriacea*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and flatback turtle (*Natator depressus*) are all listed as vulnerable species.
Biodiversity Conservation Act 2016 (Western Australia)	The primary Western Australia legislation for the protection biodiversity conservation matters.	• The green turtle, leatherback turtle, hawksbill turtle, and flatback turtle are listed under Schedule 3 — Fauna that is rare or is likely to become extinct as vulnerable fauna. • The loggerhead turtle and olive ridley turtle are listed under Schedule 2 — Fauna that is rare or is likely to become extinct as endangered fauna.
Environment Protection (Sea Dumping) Act 1981 (Commonwealth)	Regulates the loading and dumping of waste at sea. The Act fulfils Australia's international obligations under the London Protocol to prevent marine pollution by dumping of wastes and other matter.	• Sea Dumping Permits are required for all ocean disposal activities, which includes dredging operations and spoil disposal. • Future Maintenance Dredging for Pluto will require a Permit, which typically requires a Dredging Management Plan which includes management of sea turtles and other marine fauna during dredging.

Marine turtles are also recognised internationally as species of conservation concern. Six of the species found in Australia are listed in the 2000 IUCN Red List (World Conservation Union), whilst all are a 'Priority for Conservation' under the Bonn Convention (for migratory species).

It should be noted that other EPBC listed marine mammal species frequent the Dampier Archipelago. Mitigation measures in place for protecting sea turtles are considered to also reduce the risks of impact to other marine mammal species that frequent the area.

A search was conducted using the Protected Matters Search Tool (available from: http://www.environment.gov.au/epbc/protected-matters-search-tool) on 04 August 2023 to identify relevant marine mammal species that are known to or may occur within the Dampier Archipelago (**Table** 4). This plan is not applicable to impacts or management measures pertaining to EPBC listed birds or fish. Table 4 - Marine Mammal Species of Conservation Significance (EPBC Act)

Species	Common Name	Status	Type of Presence
Balaenoptera musculus	Blue Whale	Endangered, Migratory, Cetacean	Species or species habitat may occur within area
Megaptera novaeangliae	Humpback Whale	Vulnerable, Migratory, Cetacean	Species or species habitat may occur within area

Species	Common Name	Status	Type of Presence
Balaenoptera edeni	Bryde's Whale	Migratory, Cetacean	Species or species habitat may occur within area
Orcinus orca	Killer Whale, Orca	Migratory, Cetacean	Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	Migratory, Cetacean	Species or species habitat likely to occur within area
Balaenoptera acutorostrata	Minke Whale	Cetacean	Species or species habitat may occur within area
Delphinus delphis	Common Dolphin	Cetacean	Species or species habitat may occur within area
Feresa attenuata	Pygmy Killer Whale	Cetacean	Species or species habitat may occur within area
Grampus griseus	Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
Pseudorca crassidens	False Killer Whale	Cetacean	Species or species habitat may occur within area
Stenella attenuata	Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area
Tursiops aduncus	Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
Tursiops truncates s. str.	Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area
Dugong dugon	Dugong	Migratory, Listed Marine Species	Species or species habitat likely to occur within area
Orcaella heinsohni	Australian Snubfin Dolphin	Migratory, Cetacean	Species or species habitat likely to occur within area
Balaenoptera borealis	Sei Whale	Migratory, Cetacean	Species or species habitat likely to occur within area
Sousa sahulensis	Australian Humpback Dolphin	Migratory (as Sousa chinensis), Cetacean	Species or species habitat likely to occur within area
Balaenoptera physalus	Fin Whale	Vulnerable, Migratory, Cetacean	Species or species habitat likely to occur within area

1.6 Guidelines

In January 2020, the Commonwealth Department of the Environment and Energy (DoEE) published the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). The aim of the guidelines is to raise awareness of the potential impacts of artificial light on wildlife and provide a framework for assessing and managing these impacts around susceptible listed wildlife. The monitoring methodologies and management actions described in this STMP are aligned with the best-practice standards incorporated within the National Light Pollution Guidelines.

1.7 Structure of the Plan

This plan provides the following information:

- an overview of turtle species and ecology within Dampier Archipelago;
- an overview of turtle activity at Holden Beach (immediately adjacent to Site A);
- existing lighting at Holden Beach;
- identification of the key stressors, potential impacts and environmental risk assessment;
- an outline of strategies to minimise the impact associated with operations;
- an outline of monitoring procedures and programmes; and
- a list of personnel responsible for implementation of this plan.

The plan will be made publicly available on the Woodside public website, following approval by regulators.

2. Sea Turtle Ecology in the Dampier Archipelago

Of the seven marine turtle species found globally, six are known to occur in the waters within the Dampier Archipelago (EA 1998). These include the:

- green turtle (*Chelonia mydas);*
- hawksbill turtle (*Eretmochelys imbricate)*;
- leatherback turtle (*Dermochelys coriacea*);
- flatback turtle *(Natator depressus);*
- loggerhead turtle (*Caretta caretta*); and
- olive ridley turtle (*Lepidochelys olivacea).*

Of the above noted species, the leatherback, loggerhead and olive ridley turtles are found to a lesser extent within the Dampier Archipelago. A summary of the general sea turtle ecology (i.e. habitat and foraging behaviour, diet, nesting activity) for Australia and the Dampier Archipelago is provided within **Table 5.**

2.1.1 Habitat Critical to the Survival of a Species

Under the Recovery Plan for Marine Turtles in Australia 2017-2027 (DoEE, 2017) the waters surrounding the Dampier Archipelago are designated '*habitat critical to the survival of a species*' for nesting and internesting flatback, green and hawksbill turtles. For flatback turtles, the 'habitat critical' is designated under the Recovery Plan as an internesting buffer with a 60 km radius around the Dampier Archipelago (including Delambre Island and Huay Island) (**Figure 2**), across a nesting period from October to March. For green and hawksbill turtles, the 'habitat critical' is designated under the Recovery Plan as an internesting buffer with a 20 km radius around the Dampier Archipelago (**Figure 2**), across a nesting season of November to March for green turtles and October to February for hawksbill turtles (DoEE, 2017).

Table 5 - Sea Turtle Ecology in the Dampier Archipelago

Name	Habitat	Diet	Nesting
Leatherback turtle (*Dermochelys coriacea*)	Leatherback turtles occur in tropical and temperate waters of Australia. Large numbers of leatherback turtles feed off the south Queensland and New South Wales coasts and off Western Australia's coast, south of Geraldton. They are less abundant in the tropical waters of the northern Australian continental shelf. Most leatherback turtles living in Australian waters migrate to breed in neighbouring countries, particularly in Java (Indonesia) and along the northern coast of West Papua, Papua New Guinea and the Solomon Islands. There are no defined Biologically Important Areas (BIAs*) for leatherback turtles in the Dampier Archipelago, or across WA (DoEE, 2017 and 2019b).	The leatherback turtle is planktivorous throughout their life, feeding mainly in the open ocean on jellyfish and other soft-bodied invertebrates (Limpus, 2009).	Genetic linkages between populations of leatherback turtles in Australia are not well understood, however, evidence available indicates there are potentially three stocks within the broad area of the Indo-Pacific (DoEE, 2017). No significant rookeries have been recorded in Australia and there are no confirmed records of nesting with WA (DoEE, 2017). Scattered nesting occurs along the south Queensland coast from Cobourg Peninsula to Cape Arnhem (including Danger Point) and adjacent islands (including Wessel Islands and Elcho Island). Nesting in this region occurs between December and January (DoEE, 2017).
Green turtle (*Chelonia mydas*)	Green turtles occur in seaweed-rich coral reefs and inshore seagrass pastures in tropical and subtropical areas of the Indo-Pacific region. In the Dampier Archipelago, there are a number of defined BIAs for green turtles. The nearest foraging BIA occurs at Dixon Island approximately 27 km to the east of Pluto LNG. Other foraging BIAs include the islands between Cape Preston and Onslow, and Barrow Island (approximately 70 km and 160 km from Pluto LNG, respectively) (DoEE, 2019).	The green turtle is mainly herbivorous. Adult green turtles feed on algae, seagrass and mangroves, however, juveniles feed on algae as well as crustaceans and molluscs in their pelagic phase (Boyle and Limpus, 2008).	In Australia, there are genetically distinct breeding populations of green turtle (DoEE, 2017). The North West Shelf population, which overlaps the Dampier Archipelago, has a number of widely spread, rookeries including Adele Island, Maret Island, Cassini Island, Lacepede Islands, Barrow Island, Montebello Islands (all with sandy beaches), Serrurier Island, Dampier Archipelago, Thevenard Island, Northwest Cape, and the Ningaloo coast (DoEE, 2017). In the Dampier Archipelago there are a number of nesting BIAs for green turtles, including the islands to the west of the Burrup Peninsula, Legendre and Huay Islands and Delambre Island (3, 27 and 33 km from Pluto LNG, respectively). There is also a 20 km year-round internesting buffer BIA that covers the Dampier Archipelago and overlaps Holden Beach and the shoreline of Pluto LNG. Use level for this BIA has been defined as very low (DoEE, 2019). Nesting occurs between late November and March for the North West Shelf nesting population of green turtles. Green turtles that nest across WA are genetically linked with populations in the Cocos Islands, Christmas Island and the NT and are considered to disperse/migrate between these regions (DoEE, 2017).
Flatback turtle (*Natator depressus*)	All known breeding sites of the Flatback turtle occur in Australia.	The flatback turtle is carnivorous, feeding mostly on soft bodied	Currently, there are at least five known stocks of flatback turtles in Australia (DoEE, 2017), with the population nesting in the Dampier Archipelago part of the Pilbara stock. Flatback turtles from this stock nest on inshore islands and the mainland

Name	Habitat	Diet	Nesting
	Flatback turtles feed in the northern coastal regions of Australia, extending as far south as the Tropic of Capricorn. Their feeding grounds also extend to the Indonesian archipelago and the Papua New Guinea coast. Flatbacks have a preference for shallow, soft-bottomed sea bed habitats away from reefs. In the Dampier Archipelago, there are a number of defined BIAs for flatback turtles. The nearest foraging BIA occurs along a string of islands between Cape Preston and Onslow, inshore of Barrow Island (>70 km from Pluto LNG). A mating BIA occurs around the islands to the west of the Burrup Peninsula (approximately 3 km from Pluto LNG) (DoEE, 2017).	invertebrates such as gastropod molluscs, squid, sea cucumbers, soft corals and jellyfish (Zangerl et al, 1988).	across the region, with significant nesting locations on the Montebello Islands, Mundabullangana Beach, Barrow Island, Cemetery Beach, Dampier Archipelago, coastal islands from Cape Preston to Locker Island (DoEE, 2017). In the Dampier Peninsula there are a number of established nesting BIAs for flatback turtles. The nearest is a nesting BIA on Intercourse Island (approximately 15 km west of Pluto LNG). Use level at this BIA is defined as low. Other nesting BIAs in close proximity to Pluto LNG include Legendre and Huay Islands, Delambre Island, Dixon Islands and west of Cape Lambert (all >25 km from Pluto LNG). There is also an 80 km year-round internesting buffer BIA that covers the Dampier Archipelago and overlaps Holden Beach and the shoreline of Pluto LNG. Use level for this BIA has been defined as very low (DoEE, 2017). Nesting activity occurs during summer, between October and March (DoEE, 2017).
Loggerhead turtles (*Caretta caretta*)	Loggerheads occur in coral reefs, bays and estuaries in tropical and warm temperate waters, foraging in all coastal states and the NT and travelling as far as South America (Boyle et al, 2009). In the Dampier Archipelago, there are no defined foraging BIAs for loggerhead turtles, however, an internesting BIA has been defined for the area (inclusive of two 20 km buffers around Rosemary and Cohen Islands). There is a low level of use associated with these BIAs (DoEE, 2017).	Loggerheads are carnivorous, feeding mostly on benthic invertebrates including shellfish, crabs, sea urchins and jellyfish. The loggerhead turtle feeds mainly from nearshore to 55 m water depth (Limpus, 2009).	In Australia, loggerhead turtles occur as two genetically distinct stocks, nesting in the southern Great Barrier Reef (south-west Pacific stock), and in Western Australia. Low numbers of loggerhead turtles nest in the Dampier Archipelago (on Rosemary and Cohen Islands), and the main nesting sites for this population occur on Dirk Hartog Island, Muiron Islands, Gnaraloo Bay, and the Ningaloo coast (DoEE, 2017). No nesting BIAs have been defined in the Dampier Archipelago, however, a 20 km internesting buffer BIA does overlap the region and the shoreline along Pluto LNG. Loggerheads tagged in Western Australia have been recaptured in the Northern Territory, Western Australia and Indonesia. In WA, loggerhead turtles nest from November to May (DoEE, 2017).
Hawksbill turtle (*Eretmochelys - imbricata*)	Hawksbills typically occur in tidal and sub-tidal coral and rocky reef habitats throughout tropical waters, extending into warm temperate areas as far south as northern New South Wales. In Australia the main feeding area extends	Hawksbill turtles are omnivorous. Sponges make up a major part of the diet of hawksbills, although they also feed on	There are three major hawksbill turtle breeding stocks in Australia including the north Queensland stock, the north-east Arnhem Land stock and the north west shelf of WA stock (DoEE, 2017). The most significant rookeries in the north west shelf include Dampier Archipelago (including Rosemary Island and Delambre Island), Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island), Lowendal Islands (including Varanus Island,

Name	Habitat	Diet	Nesting
	along the east coast, including the Great Barrier Reef. Other feeding areas include Torres Strait and the archipelagos of the Northern Territory and Western Australia, possibly as far south as Shark Bay or beyond. In the Dampier Archipelago, there are a number of defined BIAs for flatback turtles. The nearest foraging BIA occurs at Dixon Island approximately 27 km to the east of Pluto LNG. Other foraging BIAs include the islands between Cape Preston and Onslow, and Barrow Island (approximately 70 km and 160 km from Pluto LNG, respectively) (DoEE, 2017).	seagrasses, algae, soft corals and shellfish (Bell, 2012; Whiting and Whiting, 2014).	Beacon Island and Bridled Island), and Sholl Island (DoEE, 2017). In the Dampier Archipelago there are a number of established nesting BIAs for hawksbill turtles. The nearest is a nesting BIA on Delambre and surrounding islands (approximately 3 km of Pluto LNG). Use level at this BIA is defined as high. There is also a 20 km year-round internesting buffer BIA that covers the Dampier Archipelago and overlaps Holden Beach and the shoreline of Pluto LNG. Other nesting BIAs in proximity to Pluto LNG include Barrow and the Montebello Islands (>100 km west of Pluto LNG) (DoEE, 2019). Nesting in Western Australia occurs between October and February (DoEE, 2017).
Olive ridley turtle (*Lepidochelys olivacea*)	The olive ridley turtle has a worldwide tropical and subtropical distribution, including northern Australia. Olive ridley turtles occur in shallow, protected waters, especially in soft-bottomed habitats. In Australia, they occur along the coast from southern Queensland and the Great Barrier Reef, northwards to Torres Strait, the Gulf of Papua, Gulf of Carpentaria, Arafura Sea and Joseph Bonaparte Gulf in Western Australia. In the Dampier Archipelago, there are no defined foraging BIAs for loggerhead turtles, however, there are a number of nesting BIAs (DoEE, 2019).	The olive ridley turtle is primarily carnivorous, feeding mostly on soft-bodied invertebrates, including sea pens, soft corals, sea cucumbers and jellyfish. The feed in water depths between 15 – 200 m (Limpus, 2009).	There are at least two genetic stocks of olive ridley turtles in Australia, including a nesting population in the NT and a nesting population in western Cape York, Qld. There is also nesting in low numbers along the Kimberley coast, however, the genetic relationship between these turtles and populations in NT and Qld is unknown (DoEE, 2017). It is suggested olive ridley turtles in the Kimberley and WA may migrate from international waters. A number of BIAs have been recently established in WA to protect nesting olive ridley turtles in the Kimberley. All four of these nesting BIAs occur north east of Broome in the Dampier Peninsula (>770 km from Pluto LNG). Nesting at these locations occurs between May and July (Prince et al, 2010).

** 'Habitat critical to the survival of a species' and BIAs are defined in the Recovery Plan for Marine Turtles in Australia and the National Conservation Values Atlas (NCVA) (DoEE, 2017, 2019b). Where BIAs closely relate to spatially defined 'habitat critical', areas have been merged and described as one.*

2.1.2 Nesting and Internesting

Significant nesting and internesting aggregation areas for sea turtles occur within the Dampier Archipelago, as reported in the NCVA and the Recovery Plan for Marine Turtles in Australia (DoEE, 2017, 2019), and are shown in **Figure 2** (as well as summarised in **Table 5**). **Figure 2** highlights that marine turtles, predominantly flatback, green and hawksbill turtles, nest across the Dampier Archipelago, with most nesting occurring on Rosemary, Delambre, Enderby, Eaglehawk, Angel and Legendre islands (CALM, 1990; Pendoley et al., 2016; Biota, 2009; Whiting, 2018).

An internesting period denotes the time between each successful nesting period during a nesting season (all species of marine turtles lay several clutches of eggs during a nesting season). Many adult turtles are known to remain in relatively close proximity to their nesting beaches during internesting periods. Whittock et al. (2014) tracked flatback turtles from beaches on the east coast of Barrow Island, finding the mean displacement of internesting females was 25.7 and 27.2 km from Thevenard Island and Barrow Island, respectively. These results indicate that internesting turtles remain in continental shelf waters, which is consistent with the distribution of preferred foraging habitat of soft-bottomed shallow continental shelf waters (Limpus, 2007).

As turtles leave their nesting beaches they typically spread out and consequently, density decreases rapidly with increasing distance from a nesting beach (Waayers et al., 2011; Whittock et al., 2014). It is likely that marine turtles remain in general proximity of nesting beaches during internesting periods to forage in shallow waters along the mainland coastline, as well as around offshore islands and shoals in the Dampier Archipelago.

Based on monitoring conducted at Holden Beach during the construction phase of Pluto Foundation, the key breeding and nesting periods at Holden Beach are similar to other locations in the Pilbara and Dampier Archipelago. A breakdown of typical Pilbara sea turtle nesting activity is provided within **Table 6**.

Table 6 - Pilbara Sea Turtle Breeding Timing across Species (taken from Pendoley 2007)

Breeding Activity	Month											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Adults mating												
Adults, nesting and inter-nesting												
Egg development (6-8 weeks)												
Hatchlings emerge												

2.1.3 Migratory and Foraging Patterns

Tracking data indicates the three main turtle species recorded in the Dampier Archipelago travel and forage in coastal waters that are relatively shallow (Chevron Australia Pty Ltd, 2015), as follows:

- hawksbill turtles – less than 10 m deep;
- green turtles – less than 25 m deep; and
- flatback turtles – less than 70 m deep.

Post-nesting migratory routes for green, hawksbill and flatback turtles were recorded for the Northwest Marine Region (from Barrow Island and mainland sites) (Chevron Australia Pty Ltd, 2015). Green, flatback and hawksbill turtles travelling from nesting sites to foraging grounds generally travelled east or south of Barrow Island and around or through the Dampier Archipelago and along the coast towards foraging grounds to the north (north of Broome). The hawksbill turtle was an exception as it tended to travel south to the coastal island chain south of Barrow Island (Chevron Australia Pty Ltd, 2015). As shown in **Figure 2**, there is a defined foraging BIA for green and hawksbill turtles around Dixon Island.

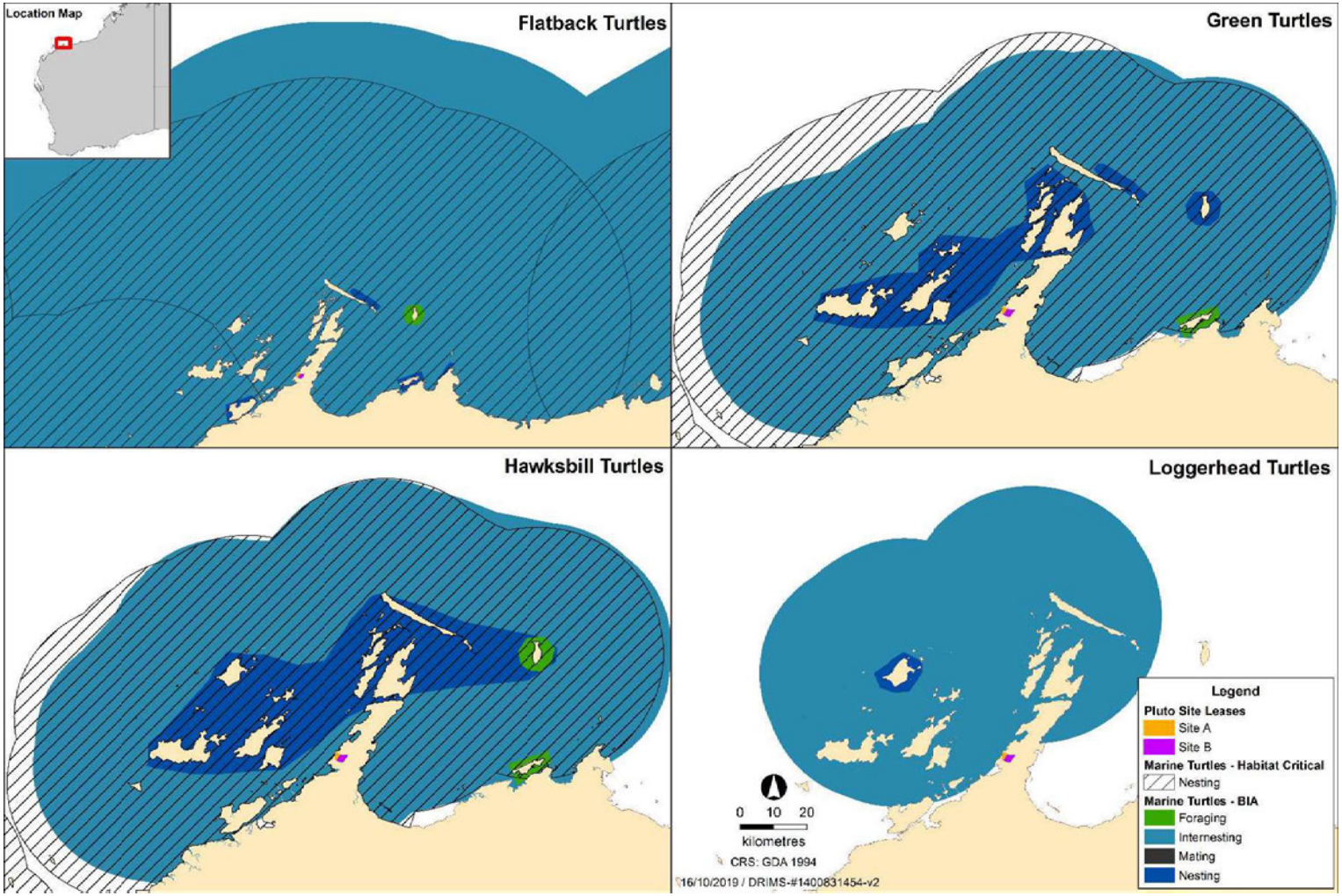

Figure 2 – Habitat Critical and BIAs for Sea Turtle Species within the Dampier Archipelago (DoEE, 2017)

2.2 Sea Turtle Activity at Holden Beach

2.2.1 Pre-construction Monitoring Results

Holden Beach is a north-west facing beach, approximately 590 m in length, situated immediately south of the existing Pluto LNG jetty, on the western coast of the Burrup Peninsula. The beach is split into two beaches by a rocky outcrop, which extends into the intertidal zone (**Figure 3**).

Two periods of baseline sea turtle surveys of Holden Beach were conducted prior to commencing construction of Pluto Foundation. The first was conducted during 22 December 2005 and 3 - 4 January 2006 by Pendoley Environmental (Pendoley 2005b and 2006). The surveys noted:

- No evidence of sea turtle nesting activity was present on the northern half of Holden Beach.
- Turtle activity was observed between the creek bed and the rocks located halfway along the beach. The supratidal sand in this area was less compact than elsewhere on the two (north and south) beach areas.
- The southern portion of Holden Beach was primarily being used by low numbers of flatback turtles during early January 2006.
- There was no evidence of marine turtle tracks or nests occurring overnight.
- One set of relatively unweathered flatback turtle tracks were identified. There was no nest associated with these tracks.
- Thirteen body pits characteristic of green and/or flatback turtle nesting attempts were observed, however weathering of the tracks and nests prevented accurate identification of species and quantification of nesting success rate. Three of these pits were associated with visible nests, with the relatively shallow nature of the body exit pits suggesting these were likely made by flatback turtles. A single nest had emerged the night before the survey. While the exact location of the nest could not be found the size of the tracks indicate that the nest was from a flatback turtle (track width on dry flat sand was 11.5 cm wide; Pendoley 2005b). The estimated location of the nest was half way along the southern beach, immediately in front of the rocky outcrop backing the beach.
- There was evidence of numerous vehicle tracks through the nesting area. Continual use of the beach by vehicles may compact sand over time and reduce the chance of nests developing or emerging successfully.

The results of the first surveys provided an initial baseline of sea turtle usage of Holden Beach prior to construction of Pluto LNG. It was noted that these results represented a snapshot of Holden Beach sea turtle nesting populations based on limited data collected over a small portion of nesting seasons. In addition, hawksbill turtles are known to begin nesting in October/November, which is earlier than other species in the region such as green and flatback turtles. The surveys are therefore likely to have missed the opportunity to detect the presence of hawksbill turtles at Holden Beach.

Subsequently, a second period of surveying was conducted. Woodside staff commenced daily visual inspections of Holden Beach from 1 January 2007 to 8 June 2007 as part of the site preparation environmental monitoring programme (FWW 2007a). The aim of this program was to record evidence of adult sea turtles using Holden Beach. There was no evidence of adult sea turtles on Holden Beach during this monitoring period.

Figure 3 - Image of Holden Beach at low tide

2.2.2 Pluto Foundation Construction Monitoring Results

During the construction phase of Pluto Foundation, Holden Beach was monitored for nesting sea turtles. Trained personnel conducted daily track surveys at Holden Beach between 30 September and 1 May each year for the 2007-2008, 2008-2009 and 2009-2010 nesting seasons. These periods coincided with the nesting seasons of the flatback, green and hawksbill turtles.

Marine turtle tracks were used to identify species. The results of the track surveys from Holden Beach are summarised within **Table 7**. One adult "track" is counted as one up and one down movement, i.e. one land excursion for an individual turtle. To prevent double counting, a line is drawn through each track once identified. The number of "body pits" is the number of visible pits including primary body pits where a nest was attempted, and secondary body pits that accompany potential nest mounds. "Confirmed nests" are only counted after evidence of hatchling emergence is observed.

Table 7 - Sea Turtle Track Counts from the 2007-2010 Nesting Seasons at Holden Beach

Nesting Season	Number of Adult Tracks	Number of body pits	Number of confirmed nests	Number of hatchling tracks
2007 – 2008	7	12	5	118
2008 – 2009	0	0	0	0
2009 – 2010	12	13	4	101

In addition to track counts, nest fan measurements of all hatched turtle nests on Holden Beach were recorded during the surveys. Nest fan measurements were recorded to identify the behaviour of hatchlings in response to light during the sea-finding behaviour and to confirm the actual nesting activity on the beach. Five nest fan measurements were recorded during the 2007-2008 nesting season. Of these, one nest indicated hatchling disorientation with a wide angle spread of emergent tracks. It is unclear

whether the source of light causing the disorientation was natural or anthropogenic in origin.

While the results in **Table 7** suggest Holden Beach does not support a major sea turtle rookery (Pendoley 2010), Woodside acknowledges that all suitable nesting locations for sea turtle species are important given their conservation status (see Section 2). There are limited alternative nesting beaches nearby along the shoreline between the King Bay Supply Base and the Karratha Gas Plant LNG Facility, with the only other potential nesting beach, near No Name Bay, located ~500 m north of Holden Beach. Key sea turtle nesting locations are located towards the outer Dampier Archipelago on Rosemary and Legendre Islands.

It is Woodside's view that any beach that provides, or potentially provides, habitat for nesting sea turtles shall be appropriately managed.

2.2.3 Operations Monitoring Results

Results gathered from sea turtle monitoring on Holden Beach during the operations phase of Pluto LNG to date are presented in **Table 8**.

Table 8 - Turtle monitoring results during PGP operational phase

Nesting Season	Number of Adult Tracks	Number of body pits	Number of confirmed nests	Hatchling Tracks
2010 - 2011	0	0	0	0
2011 - 2012	7	4	1	27
2012 - 2013	7	8	2	26
2013 - 2014	3	5	1	26
2014 - 2015	9	14	8	141
2015 - 2016	2	2	0	0
2016 - 2017	15	15	6	109
2017 - 2018	8	9	3	56
2018 - 2019	6	11	4	59
2019 – 2020	0	0	0	0
2020 – 2021	5	4	1	9
2021 - 2022	1	0	0	0
2022 - 2023	7	6	4	75
2023 - 2024	9	5	4	88
Mean	5.6	5.9	2.4	44.0
Standard Deviation	4.2	4.9	2.5	45.4

Similar to results from prior to and during construction, nesting activity on Holden Beach displays high variance in annual nesting activity. The evidence of continued nesting effort and successful hatchling emergence suggests that there has been no observable negative impact from Pluto construction and operations.

Sea Turtle Monitoring Results Associated with Pluto LNG (Box et al. 2014), presented at the Second Western Australian Marine Turtle Symposium discussed monitoring results to date and concluded that although frequency of turtle nesting was highly

variable on an annual basis, Holden Beach does not support a major sea turtle rookery. Ongoing monitoring results have supported this finding.

Three observations of hatchling mis-orientation have been made during 10 years of operations monitoring, however no hatchling mortality has been recorded during any of these events. Following the procedure described in Section 4.2, an investigation was conducted into each event to identify potential light impact pathways and mitigation actions. Where findings indicated a potential Pluto light source to be the cause, action was taken to ensure alignment with the approved Pluto Operational Lighting Specification. No repeat observations have been recorded.

2.3 Light Sources within the Region

2.3.1 Existing Light Sources with proximity to Holden Beach

A number of existing and external sources of light are located within close proximity to Holden Beach which contribute to ambient light levels (**Table 9** and **Figure 4**).

Table 9 - Existing Lighting Sources near Holden Beach during current Operations

Infrastructure	Distance/ Direction from Holden Beach	Lighting observed from Holden Beach
Pluto LNG Jetty	Adjacent to Holden Beach	Direct line of sight
Pluto LNG Storage and Loading Flare (Site A)	0.21 km east	Direct line of sight
Pluto LNG Site A infrastructure	Adjacent to Holden Beach	Light overspill/glow
Pluto LNG Flare stack (Site B)	1.18 km east	Light overspill/glow
Dampier Cargo Wharf	1.1 km south	Direct line of sight
Bulk Liquids Berth	1.7 km south	Direct line of sight
NWSV LNG Facility	1.6 km north	Direct line of sight
Dampier Port Authority- Cargo Wharf Adiminstration Building	1 km south	Light overspill/glow
King Bay Supply Base	1.8 km south	Light overspill/glow
LNG Tankers/ Vessels (Transient)	Not applicable	Light overspill/glow

While nearby infrastructure continues to emit light, the likelihood of natural darkness periods occurring at Holden Beach are limited. There is still a need, however, to consider cumulative impacts of lighting (both direct light and glow) on sea turtles that utilise land and water in close proximity to Site A. Therefore, a sensible and strategic management approach to minimise the impact of lighting is an essential component of this Sea Turtle Management Plan (refer to Section 4).

The Pluto Light Management Plan (LMP) is provided within Appendix B. The focus of the LMP is on the mitigation of installed lighting at Pluto LNG, with a focus on the management of defined zones. The Pluto LNG Storage and Loading flare (Site A), while nearby, is not the focus of the LMP. To further reduce the risk of impact from the storage and loading flare, loading activities would need to be scheduled for daylight only hours. The significant costs of instituting this measure are grossly disproportionate to the benefit gained in risk reduction. This would increase the risk of "tank tops" events, during which LNG and/or condensate tanks would reach maximum safe levels, and production would become constrained. The monitoring results gathered over time have not shown that flaring has had a significant impact (Section 2.2). This indicates that the benefit, being reduced likelihood of marine turtle disorientation, is disproportionate with the potential production impacts.

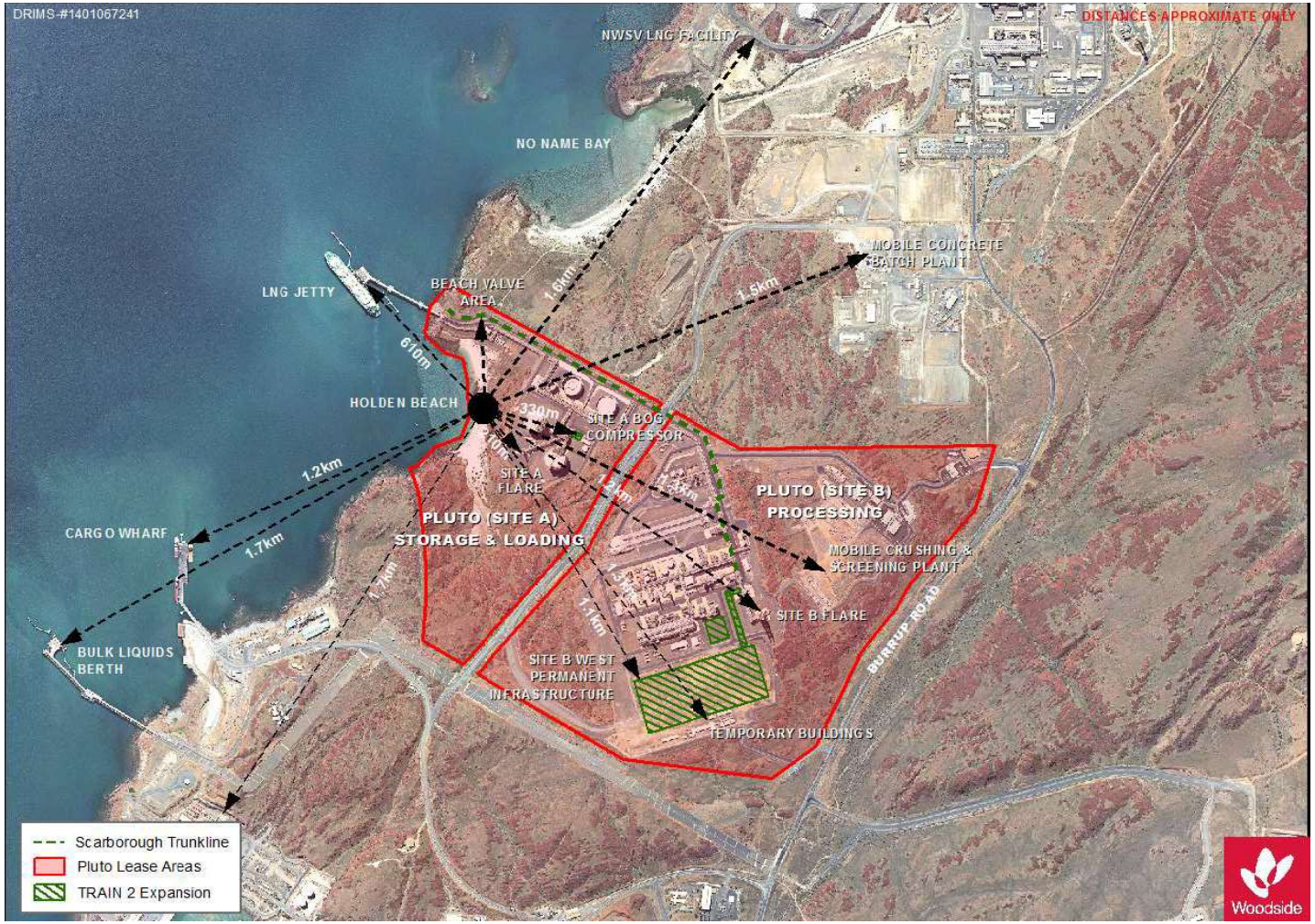

Figure 4 - Existing and proposed lighting sources within close proximity to Holden Beach

2.3.2 Pluto Expansion

Permanent Pluto Expansion – Onshore facilities include:

- second LNG train (approximately 5 mtpa capacity), and associated utilities/infrastructure; and
- modifications to the existing Pluto Train 1.

The new infrastructure and new permanent lighting sources for Pluto Expansion will be located some distance from Holden Beach, and obscured by topography and existing infrastructure (Figure 4).

Temporary facilities and utilities are also required to support the construction-phase of the Pluto Train 2 Project. The key temporary facilities include:

- temporary lighting to support construction of second LNG train;
- temporary buildings; and
- mobile crushing and screening plant.

The indicative locations of additional permanent sources of light in close proximity to Holden Beach are shown in **Table 10** and **Figure 4.**

Table 10 – Approximate locations of additional Permanent Lighting Sources near Holden Beach

Infrastructure	Distance/ Direction from Holden Beach	Lighting observed from Holden Beach
Boil off gas (BOG) compressor on Site A	0.32 km	Light overspill/glow
Pluto LNG Site B West permanent infrastructure	1.1 km east	Light overspill/glow

3. Environmental Risk Assessment

An assessment of environmental risk to sea turtles has been undertaken using Woodside's environmental risk matrix (refer to Appendix A). This assessment methodology is consistent with standard risk management process and practice as outlined in the Australian risk management standard (AS/NZS 4360). The risk assessment presented in Appendix A has been tailored to be specific to Holden Beach sea turtle nesting populations.

This risk assessment is also consistent with the best-practice standards for environmental impact assessment of artificial light on marine turtles, as included in Appendix F of the National Light Pollution Guidelines (Commonwealth of Australia, 2020).

The criteria that have been applied to determine 'likelihood' and 'consequence' of each potential impact/project activity are presented within Appendix A. The risk level is derived from the consequence and likelihood levels determined above in accordance with the risk matrix are shown in **Figure 5**.

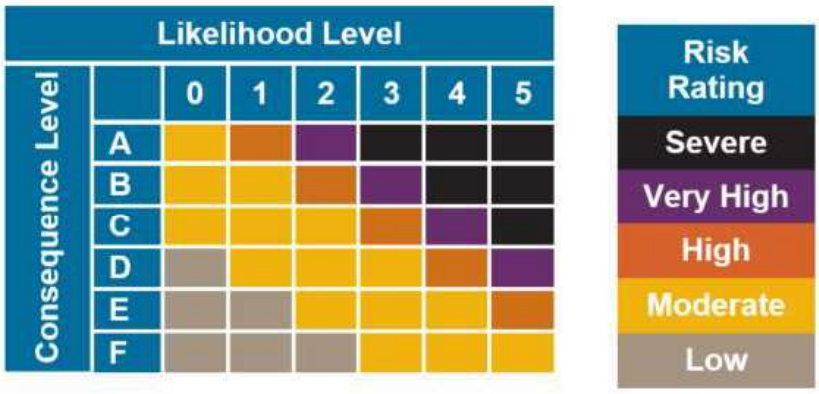

Figure 5 Woodside risk matrix – risk level

Table 11 and **Table 12** present the results of the risk assessment process and identifies the inherent risk (unmitigated risk) and residual risks (mitigated risks) to sea turtle populations associated with Pluto LNG, for Pluto Foundation – Existing Operations and Pluto Expansion – Construction respectively. The risk assessment is based on the following assumptions:

- The likelihood rating (remote – highly likely) is based on the likelihood of an impact occurring to Holden Beach sea turtle populations as opposed to the likelihood of an event occurring.
- The consequence rating (no lasting effect – catastrophic) is based on the most probable consequence resulting from the likelihood of an impact occurring to sea turtle populations, taking into consideration external factors such as existing light at Holden Point from surrounding sources.

Should any additional impacts to sea turtles and their habitats be identified during operations and associated maintenance, the plan shall be revised and additional management measures developed and implemented. This would be undertaken in consultation with DWER and the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The following aspects and stressors have been assessed as not credible or relevant during operations or construction of Pluto Expansion phases:

- Habitat loss during Expansion, as there is no further clearing proposed and all works are within the existing disturbance footprint.
- Noise and vibration due to marine blasting (as none is proposed).
- Coastal processes during Expansion, as all marine infrastructure was installed during the construction phase of the Foundation project, and no new infrastructure is proposed for Expansion. Note that the Scarborough project is subject to separate environmental approvals, and is outside the scope of this STMP.

Table 11 - Summary of Key Potential Environmental Risks to Sea Turtle and Marine Mammal Populations - Operations

Project Activity	Aspect	Activity	Potential Impact(s) and Consequences to Sea Turtle	Consequences (population)	Likelihood (Population)	Inherent Risk	Mitigation and Management	Consequences	Likelihood	Residual Risk
Site A – LNG and Condensate Storage Facility	Light	Operation	Potential impacts may include: • disruption of turtle nesting activity (i.e. deter females from emerging onto the beach) on Holden Beach; • light overspill or glow from the operation of infrastructure at Site A may lead to disorientation of turtle hatchlings; • hatchling sea turtles may be attracted to lights on boats/barges moored offshore at night; • hatchling sea turtles may be attracted to temporary lighting and permanent lights required for operation of facilities within Site A. The potential consequences of disruption to sea turtle nesting activity may include: • reduced nesting success; • disorientation due to artificial lighting, resulting in increased mortality of emerging hatchlings due to dehydration, predation, and exhaustion. Additionally, hatchlings trapped by light spill from jetty and vessel lights may be concentrated within a small area exposing them to predation.	E	3	M	Table 13, OS1	E	1	L
	Human Presence	Operation	Potential impacts may include: • disruption of adult nesting; • reduced hatching and hatchling emergence success. Potential consequences of disruption to nesting activity may include: • sea turtles abandoning nesting and returning to the water.	E	3	M	Table 13, OS3	E	0	L
Jetty adjacent to Site A and operations and maintenance vessel activity (excluding third-party tankers)	Water Quality	Operation	Potential impacts would be limited to maintenance activities. This may include: • increased total suspended solids in water column in vicinity of dredge/disposal activities; • altered sea turtle behaviour (i.e. avoidance) during dredging operations from plumes of suspended sediments; • plumes associated with LNG and condensate tanker propeller wash during berthing and departure operations may deter turtles from entering the immediate area. Potential consequences may include: • sea turtles being deterred from entering areas important for foraging and breeding or from accessing beaches used for nesting.	E	2	M	Table 13, OS6	F	2	L
	Physical Presence	Operation	Potential impacts may include: • direct striking caused by the physical presence of marine infrastructure installation vessel(s); • operations and maintenance vessels (excluding third-party tankers) movement in Mermaid Sound may result in increased propeller and/or vessel strike. The potential consequence is increased sea turtle or marine mammal injury and/or mortality from vessel strike.	E	3	M	Table 13, OS6	E	2	M
	Light	Operation	Potential impacts may include: • sea turtle hatchlings being attracted to permanent light sources located on the jetty; • hatchling sea turtles being attracted to lights onboard LNG and condensate tankers loading from the jetty at night;	E	3	M	Table 13, OS1	F	2	L

Project Activity	Aspect	Activity	Potential Impact(s) and Consequences to Sea Turtle	Consequences (population)	Likelihood (Population)	Inherent Risk	Mitigation and Management	Consequences	Likelihood	Residual Risk
			• hatchling sea turtles being attracted to lights onboard vessels moored or operating in Mermaid Sound at night. Potential consequences may include: • hatchlings trapped by the light spill from jetty and vessel lights being concentrated within a small area exposing them to predation; • physical exhaustion of hatchlings from maintaining position under infrastructure lighting, after entering the water.							
	Hydrocarbon spill	Operation	Potential impacts may include: • sea turtles/ hatchlings being smothered by hydrocarbon spills; • hydrocarbon spill deterring nesting/foraging turtles from entering the immediate area; • loss of foraging habitat because of hydrocarbon spill into the marine environment. Potential consequences may include: • hatchling mortality due to smothering with hydrocarbons; • nesting and foraging activity by adult sea turtle being reduced leading to a loss of available habitat.	E	2	M	Table 13, OS2	E	1	L
Dredging works as part of operational maintenance.	Physical Presence	Maintenance Dredging	Potential impacts may include: • direct striking/ impact from physical presence of dredge vessel and support vessels; • sea turtles coming in contact with the dredge head (i.e. Trailer Suction Hopper Dredge (TSHD) or the Cutter Suction Dredge (CSD)). Potential consequences relate to increased sea turtle injury and/or mortality from vessel strike or interaction with dredge drag head.	E	5	H	Table 13, OS4 Section 4.2 of this plan (Dredging and Spoil Disposal Procedure)	E	3	M
	Light	Maintenance Dredging	Potential impacts may include: • sea turtle hatchings being attracted to lights onboard dredge vessel(s); • adult sea turtle being deterred from nesting/foraging activities. Potential consequences may include: • hatchlings trapped by the light spill from vessel lights being concentrated within a small area exposing them to predation; • physical exhaustion of hatchlings from maintaining position under dredge lighting, after entering the water; • nesting and foraging activity by adult sea turtle being reduced leading to a loss of available habitat.	E	3	M	Table 13, OS6 Section 4.2 of this plan (Dredging and Spoil Disposal Procedure)	E	2	M
	Water Quality	Maintenance Dredging	Potential impacts may include: • plumes of suspended solids deterring turtles from entering the immediate area, during dredging operations; • suspended solid plumes reducing visibility in sea turtle foraging habitat. The potential consequence is that sea turtles may be deterred from using Holden Beach for nesting and/or utilising foraging areas.	E	3	M	Table 13, OS4 Section 4.2 of this plan (Dredging and Spoil Disposal Procedure)	F	2	L
	Habitat Loss	Maintenance Dredging	Potential impacts may include: • loss of habitat as a result of inappropriately managed activities (e.g. dredging) in the marine environment; and • habitat loss may be direct (i.e. direct removal from dredging), or indirect (i.e. loss of habitat due to changes in water quality/turbidity during construction).	E	1	L	Table 13, OS4 Section 4.2 of this plan (Dredging and Spoil Disposal Procedure)	F	2	L

Project Activity	Aspect	Activity	Potential Impact(s) and Consequences to Sea Turtle	Consequences (population)	Likelihood (Population)	Inherent Risk	Mitigation and Management	Consequences	Likelihood	Residual Risk
			The potential consequence is habitat loss that may result in reduced area for sea turtle foraging and mating.							
Spoil disposal within and outside of Mermaid Sound (associated with dredging works as part of operational maintenance).	Physical Presence	Spoil Disposal	Potential impacts may include: • sea turtle burial/strike during dredge spoil disposal activities. Potential consequences may include: • Increased sea turtle injury and/or mortality from vessel strike or burial by dredge spoil.	E	2	M	Table 13, OS4 Section 4.2 of this plan (Dredging and Spoil Disposal Procedure)	E	0	L
	Water Quality	Spoil disposal	Potential impacts upon sea turtles from elevated suspended solids in the water column include: • turtles being deterred from entering the immediate area; and • temporary disruption to feeding and foraging areas. A potential consequence is that habitat loss may result in a reduced area for sea turtle foraging and mating. Sea turtles may be deterred from entering areas important for foraging and breeding.	E	3	M	Table 13, OS4 Section 4.2 of this plan (Dredging and Spoil Disposal Procedure)	F	2	L
LNG Facility operation / Site B operation	Light	Operation – non-routine / upset condition Flaring (Site B)	Potential impacts include: • disruption of turtle nesting activity (i.e. deter females from emerging onto the beach) on Holden Beach; • light overspill or glow from the operation of temporary facilities at on elevated areas of Site B East may lead to disorientation of turtle hatchlings. Potential consequences of disruption to sea turtle nesting activity may include: • reduced nesting success; • disorientation due to artificial lighting, resulting in increased mortality of emerging hatchlings due to dehydration, predation, and exhaustion.	F	1	L	Table 13, OS5	F	0	L
Export of LNG / condensate	Light	Flaring from Storage and Loading Flare (Site A)	Potential impacts may include: • disruption of turtle nesting activity (i.e. deter females from emerging onto the beach) on Holden Beach; • disorientation of turtle hatchlings. Potential consequences of disruption to sea turtle nesting activity may include: • reduced nesting success; • disorientation due to artificial lighting, resulting in increased mortality of emerging hatchlings due to dehydration, predation, and exhaustion.	F	1	L	Table 13, OS5	F	1	L

Table 12 - Summary of Key Potential Environmental Risks to Sea Turtle and Marine Mammal Populations – Construction of Pluto Expansion

Project Activity	Aspect	Activity	Potential Impact(s) and Consequences to Sea Turtle	Consequences (population)	Likelihood (Population)	Inherent Risk	Mitigation and Management	Consequences	Likelihood	Residual Risk
Temporary Facilities – Site A	Light	Construction	Potential impacts may include: • disruption of turtle nesting activity (i.e. deter females from emerging onto the beach) on Holden Beach; • light overspill or glow from the operation of temporary facilities may lead to disorientation of turtle hatchlings. Potential consequences of disruption to sea turtle nesting activity may include: • reduced nesting success; • disorientation due to artificial lighting, resulting in increased mortality of emerging hatchlings due to dehydration, predation, and exhaustion.	D	2	M	Table 14, CS1	E	1	L
Commissioning and Start-up of Train 2	Light	Flaring	Potential impacts may include: • disruption of turtle nesting activity (i.e. deter females from emerging onto the beach) on Holden Beach; • disorientation of turtle hatchlings. Potential consequences of disruption to sea turtle nesting activity may include: • reduced nesting success; • disorientation due to artificial lighting, resulting in increased mortality of emerging hatchlings due to dehydration, predation, and exhaustion.	F	1	L	Table 13, OS5	F	1	L
Construction activities associated with Pluto Expansion	Human presence	Construction	Potential impacts may include: • disruption of adult nesting; • reduced hatching and hatchling emergence success. Potential consequences of disruption to nesting activity may include: • sea turtles abandoning nesting and returning to the water.	E	3	M	Table 14, CS3	E	0	L
Construction activities associated with Pluto Expansion	Hydrocarbon Spills	Construction	Potential impacts would be limited to onshore hydrocarbon spill. This may include: • reduction in water quality in vicinity of surface water release from Pluto site; • altered sea turtle behaviour (i.e. avoidance) due to presence of hydrocarbons in the water column. Potential consequences may include: • sea turtles being deterred from entering areas important for foraging and breeding or from accessing beaches used for nesting.	F	2	L	Table 14, CS2	F	1	L
Construction/ earthworks (Site A and B)	Noise and vibration	Construction	Potential impacts may include: • noise from construction activities discouraging adult nesting activities at Holden Beach.	F	1	L	Table 14, CS4	F	1	L

4. Management Actions and Strategies

4.1 Overview

Management measures to be implemented during the operation and Pluto Expansion construction phases are outlined in **Table 13** and **Table 14** respectively. The management measures addressing the operations and expansion activities have been reviewed and updated considering turtle monitoring data collected during previous years of construction and operation (2007-2022).

Management actions and strategies have been developed in accordance with the Draft PER mitigation and control measures (Woodside 2006), as well as recommended actions from specific sea turtle studies (i.e. Pendoley 2010), the Recovery Plan for Marine Turtles in Australia (DoEE, 2017) and the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). The minimum standards outlined in the APPEA Code of Environmental Practice have also been adopted, and in many cases proposed management strategies exceed these guidelines (APPEA, 2008).

Table 13 - Management Measures for Operations (including Operation of Train 1 and Train 2)

Reference	Project Activity	Management Objective	Key Management Measures	Performance Measures/ Targets	Proceeding actions if/when an impact is detected	Related Management Measures / Plans	Responsibility
OS1	Onshore Lighting (LNG Storage Area Site A and Jetty)	To minimise the impact of lighting on sea turtles, including nesting and hatchling activity.	• Implementation of the Pluto LMP (Appendix B). The plan contains: - Objectives - Detail on best practice lighting design, including the management principles outlined in the National Light Pollution Guidelines for Wildlife - Detail on personnel roles and responsibilities. - Detail on Holden beach light monitoring and auditing. - Guidance for the management of light impacts for construction and temporary operations	No incidents of adult or hatchling sea turtles being disoriented by light associated with Pluto LNG.	• In the event that evidence of turtle disorientation resulting from Pluto LNG is recorded, investigation will be undertaken to determine the source(s) of light responsible for the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020) APPEA Code of Environmental Practice (APPEA, 2008) Recovery Plan for Marine Turtles in Australia (DoEE, 2017) Pluto LMP (Appendix B)	Woodside Design Contractor
OS2	Offshore / Nearshore Hydrocarbon Spills	To minimise the impact of offshore / nearshore hydrocarbon spills on sea turtles and marine mammals.	In the event of a hydrocarbon spill, management measures contained within the Nearshore Pipelines Oil Pollution First Strike Plan and Pluto LNG Park Oil Pollution First Strike Plan shall be implemented. The plans: • ensure the effective and timely management of hydrocarbon spills; • describe the procedure for management of hydrocarbon spills; and • provide for prompt notification of regulatory agencies in the event of a spill.	No incidents of turtle or marine mammal injury/deaths associated with oil spill from Pluto LNG.	• In the event that a turtle or marine mammal injury/death associated with oil spill is recorded, it will be reported to the Woodside Environment advisor who will report the incident to DBCA and DCCEEW (**Section 6.1**). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	Pluto LNG Development Draft Public Environmental Report/Public Environmental Review (Woodside 2006): Section 7.10.6.2. Woodside Oil Pollution Emergency Arrangements (Australia) Nearshore Pipelines Oil Pollution Response Plan Pluto Facilities Oil Spill Response Plan	Woodside / Vessel Captains
OS3	Operational Personnel	To minimise the impact of human presence on sea turtle activity on Holden Beach.	• Access to Holden Beach is restricted to key personnel, including staff involved in monitoring programs, security, health and safety, environmental and cultural heritage staff. • No vehicle access is permitted on the beach. • All relevant personnel receive an induction regarding fauna interaction and sensitive habitat locations.	No unauthorised access to Holden Beach by Woodside staff or contractors.	• In the event that unauthorised access by Woodside personnel and contractors is identified on Holden Beach, an investigation will be initiated to assess any resulting impacts and to identify and consider potential additional controls/mitigation measures that should be implemented.	Pluto LNG Cultural Heritage Management Plan	Woodside
OS4	Maintenance Dredging and Spoil disposal* **Note: capital dredging for the Scarborough Project is out of scope of this Plan.*	To minimise the impact of maintenance dredging activities on sea turtles and marine mammals.	**Habitat Loss** • Any future dredging activities would be undertaken as per requirements of the Sea Dumping Permit and associated management plan/s. **Dredging** • Evaluate future timeframes of maintenance dredging to avoid coinciding with turtle nesting and breeding season. • Vessel crews shall undertake a site induction by the Woodside Environment Advisor. • Turtle deflectors or a jetting device system shall be installed on dredge equipment to reduce the likelihood of sea turtle contact with the dredge drag head. • An assessment of sea turtle presence shall be made prior to dredging. If a sea turtle is sighted within 300 m,	No turtle or marine mammal injury/death resulting from maintenance dredging or spoil disposal activities associated with Pluto LNG.	• In the event that a turtle or marine mammal injury/death associated with dredging or spoil disposal is recorded, it will be reported to the Woodside HSE advisor who will report the incident to DBCA and DCCEEW (**Section 6.1**). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	Refer to Section 4.3 of this plan (Dredging and Spoil Disposal Procedure)	Woodside Fauna Spotter

Reference	Project Activity	Management Objective	Key Management Measures	Performance Measures/ Targets	Proceeding actions if/when an impact is detected	Related Management Measures / Plans	Responsibility
			the dredge vessel will relocate to >300 away from the turtle to commence dredging. • Any incidents relating to sea turtle injury / mortality shall be documented. • Sightings and locations of sea turtles shall be recorded in the vessel's daily log book. • If maintenance dredging occurs during turtle season, MFOs will be maintained on dredge vessels. **During transit** • For dredge vessel activity undertaken outside of dredging and spoil disposal (i.e. when the vessel is in transit), the vessels will comply with the following: - If a dolphin (other than a calf) approaches the vessel or comes within the avoidance area (50 m for dolphins and 100 m for a whale), the vessel will not change course or speed suddenly. - If a calf appears within 300 m of the vessel, the vessel will take the appropriate action to withdraw from this distance at a constant slow speed. - These measures will be implemented where it is safe and practicable to do so, relative to vessel manoeuvrability, vessel draft considerations and other vessel activity within the port. **Spoil Disposal (Physical Smothering and Foraging Area Impacts)** • An assessment of sea turtle presence shall be made prior to spoil disposal. If a sea turtle(s) is observed within 300 m, the vessel shall dump in an adjacent area >300 m away from sea turtle activity. • Any incidents relating to sea turtle injury / mortality shall be documented. • Sightings and locations of sea turtles shall be maintained in the vessel's daily log book. • All spoil grounds are located away from documented nesting areas. • The dredging method shall include disposal of spoil into spoil grounds within Mermaid Sound for the shortest period, wherever practicable. • Disposal of spoil shall be restricted to defined areas within the overall spoil ground, thus minimising the potential for suspended solids drift.				
OS5	Flaring	Minimise light spill to Holden Beach.	• Operational flaring from the main Site B flare is minimised and kept to a level that is as low as reasonably practicable. • The main Site B flare is located 1.18 km from Holden Beach, and is behind a small rise, meaning it's directly visible from only the southern end of Holden Beach. The storage and loading flare is used during storage and loading activities, or during non-routine maintenance activities A temporary flare system will be utilised during major plant shutdowns when maintenance will be undertaken on the Site B flare system. The temporary flares will be of a lower height than the existing Site B flare system and are expected to decrease the likelihood of impact	No incidents of adult or hatchling sea turtles being disoriented by light associated with Pluto LNG.	• In the event that evidence of turtle disorientation resulting from Pluto LNG is recorded, investigation will be undertaken to determine the source(s) of light responsible for the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	Draft National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020) APPEA Code of Environmental Practice (APPEA, 2008) Recovery Plan for Marine Turtles in Australia (DoEE, 2017) Pluto LMP (Appendix B)	Woodside

Reference	Project Activity	Management Objective	Key Management Measures	Performance Measures/ Targets	Proceeding actions if/when an impact is detected	Related Management Measures / Plans	Responsibility
OS6	Maintenance vessel activities (excluding LNG vessels, condensate tankers and tugs)	Minimise risk of injury/mortality to sea turtles and marine mammals.	EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, and Woodside's Marine Charterers Instructions (Doc. WM6070MV7005269) which include the following Measures: • Vessels will not travel greater than 6 knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow riding). • If the cetacean or turtle shows signs of being disturbed, vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots. Vessels operating under Woodside's Marine Charterers Instructions will comply with: • EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans,	No turtle or marine mammal injury/death resulting from vessel activities associated with Pluto LNG.	• In the event that a turtle or marine mammal injury/death associated with vessel activities is recorded, it will be reported to the Pluto environment advisor who will report the incident to DBCA and DCCEEW (**Section 6.1**). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	EPBC Regulations 2000 – Part 8 Division 8.1 Woodside's Marine Charterers Instructions (Doc. WM6070MV7005269)	Woodside

Table 14 - Management Measures for Construction-phase of Pluto Expansion

Reference	Project Activity	Management Objective	Key Management Measures	Performance Measures/ Targets	Proceeding actions if/when an impact is detected	Related Management Measures / Plans	Responsibility
CS1	Onshore lighting / Temporary lighting for Construction	To minimise the impact of lighting on sea turtles, including nesting and hatchling activity.	• For the construction of Pluto Train 2, develop and implement a project specific Light Management Plan for Site A and Site B relevant to construction phases. Measures shall include: - Objectives - Detail on best practice lighting design, including the management principles outlined in the National Light Pollution Guidelines for Wildlife - Detail on personnel roles and responsibilities. - Detail on additional Holden beach light monitoring and auditing - Additional mitigation to be employed during turtle season • Audits of lighting will be undertaken during construction against the project specific Light Management Plan.	No incidents of adult or hatchling sea turtles being disoriented by light associated with Pluto Expansion.	• In the event that evidence of turtle disorientation resulting from Pluto Expansion is recorded, investigation will be undertaken to determine the source(s) of light responsible for the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020) Project specific LMP APPEA Code of Environmental Practice (APPEA, 2008)	Construction contractor Woodside
CS2	Onshore Hydrocarbon Spills	To minimise the impact of onshore/ nearshore hydrocarbon spills on sea turtles and marine mammals.	In the event of a hydrocarbon spill, management measures contained within the Pluto LNG Park Oil Pollution First Strike Plan shall be implemented. The plans: • ensure the effective and timely management of hydrocarbon spills; • describe the procedure for management of hydrocarbon spills; and • provide for prompt notification of regulatory agencies in the event of a spill.	No incidents of turtle or marine mammal injury/deaths associated with oil spill from Pluto, Expansion.	• In the event that a turtle or marine mammal injury/death associated with oil spill is recorded, it will be reported to the Woodside HSE advisor who will report the incident to DBCA and DCCEEW (**Section 6.1**). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	Pluto LNG Development Draft Public Environmental Report/Public Environmental Review (Woodside 2006): Section 7.10.6.2. Woodside Oil Pollution Emergency Arrangements (Australia) Pluto LNG Park Oil Pollution First Strike Plan Construction Contractor HSEMP	Woodside Construction contractor
CS3	Construction Staff	To minimise the impact of human presence on sea turtle activity on Holden Beach.	• Access to Holden Beach is restricted to key Woodside personnel, including staff involved in monitoring program, security, health and safety, environmental and culture heritage staff. • No vehicle access will be allowed on the beach and strict protocols for human movement along the beach will be developed to avoid habitat disturbance and visual movement of human activity to approaching sea turtles. • All relevant personnel will receive an induction regarding fauna interaction and sensitive habitat locations.	No unauthorised access to Holden Beach by Woodside staff or contractors. Site induction includes keeping unnecessary lighting to a minimum.	• In the event that unauthorised access by Woodside personnel and contractors is identified on Holden Beach, an investigation will be initiated to assess any resulting impacts and to identify and consider potential additional controls/mitigation measures that should be implemented.	Construction Contractor HSEMP	Construction contractor
CS4	Vibration and Noise	To minimise the impact of construction noise and vibration presence on sea turtle activity on Holden Beach.	For the construction of Pluto train 2, Construction Contractor to develop Noise Management Plan which will implement management measures to control noise onsite. Management measures will include; • Use of Original Equipment Manufacturer (OEM) low noise specifications whenever practicable. • Operator awareness of potential noise problems and operating techniques to minimize noise emissions. • Maintenance for construction equipment and vehicles.	No turtle or marine mammal injury/death resulting from construction activities.	• In the event that a turtle or marine mammal injury/death associated with vessel activities is recorded, it will be reported to the Woodside Environment advisor who will report the incident to DBCA and DCCEEW (**Section 6.1**). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	Construction Contractor Noise Management Plan	Construction contractor

Reference	Project Activity	Management Objective	Key Management Measures	Performance Measures/ Targets	Proceeding actions if/when an impact is detected	Related Management Measures / Plans	Responsibility
CS5	Temporary RO seawater unit *(if activity occurs)*	Minimise risk of injury/mortality to sea turtles and marine mammals from entrainment	• RO intake located to minimise potential entrainment of sea turtle hatchlings (ie as far from Holden beach as reasonably practicable). • Screens to prevent entrainment of sea turtles and marine mammals into the RO intake.	No turtle or marine mammal injury/death resulting from vessel activities associated with the operation of the RO plant.	• In the event that a turtle or marine mammal injury/death associated with operation of the RO plant is recorded, it will be reported to the Woodside HSE advisor who will report the incident to DBCA and DCCEEW (**Section 6.1**). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.	APPEA Code of Environmental Practice (APPEA, 2008) Recovery Plan for Marine Turtles in Australia (DoEE, 2017)	Construction contractor

Note: The marine construction (trunkline installation, capital dredging and vessel activities) proposed for the Scarborough project are not in scope of this STMP.

4.2 Stressors OS1 and CS1 – Onshore Lighting

Light may appear as a direct light source from an unshielded lamp with direct line of sight to the observer or through sky glow. Where direct light falls upon a surface, be it land or ocean, this area of light is referred to as light spill. Sky glow is the diffuse glow caused by light that is screened from view but through reflection and refraction creates a glow in the atmosphere.

Scattering of light by dust, salt and other atmospheric aerosols increases the visibility of light as sky glow while the presence of clouds reflecting light back to earth can substantially illuminate the landscape (Kyba et al., 2011). White/blue light scatters more easily and further in the atmosphere compared to yellow-orange light (Kyba et al., 2011). Therefore, the distance at which direct light and sky glow may be visible from the source is dependent on the number, intensity and types of lights, and how such lights are orientated or shielded, in addition to environmental conditions.

Exposure of marine turtles to artificial light can result in changes to their natural behaviour. Witherington and Martin (2003) state that light pollution on nesting beaches is detrimental to marine turtles because it alters critical nocturnal behaviours, namely, how turtles choose nesting sites, how they return to the sea after nesting, how hatchlings find the sea after emerging from their nests and how they disperse once they are in the sea.

Although individuals undertaking internesting, migration, mating or foraging may occur within the Dampier Archipelago region, marine turtles do not use light cues to guide these behaviours. As such, light emissions are unlikely to result in displacement of, or behavioural changes to, individuals in these life stages.

Nesting Females

Adult female marine turtles return to land, predominantly at night, to nest on sandy beaches, relying on visual cues to select, and orient on, nesting beaches. That artificial lighting on or near beaches has been shown to disrupt nesting behaviour is relatively well documented (see Witherington and Martin, 2003 for review). Beaches with light spill, such as those located adjacent to urban developments, roadways and piers, often have lower densities of nesting females compared to beaches with less development (Salmon, 2003; Hu et al., 2018). Further, on completion of laying, nesting females are thought to use light cues in order to return to open ocean, orientating towards the brightest light (Witherington and Martin, 2003). However, observations of nesting females and emerging hatchlings at the same beach showed that females were disorientated much less frequently than hatchlings (Witherington, 1992a) indicating that nesting females are less vulnerable to impacts of artificial light on sea finding.

Hatchling Emergence

Hatchling turtles emerge from the nest, typically at night (Mrosovsky & Shettleworth, 1968), and must rapidly reach the ocean to avoid predation (Salmon 2003). Hatchlings locate the ocean using a combination of topographic and brightness cues, orienting towards the lower, brighter oceanic horizon, and away from elevated darkened silhouettes of dunes and/or vegetation behind the beach (Pendoley & Kamrowski, 2015; Lohmann et al 1997; Limpus & Kamrowski 2013).

Artificial lights interfere with natural light levels and silhouettes disrupt hatchling sea finding behaviour (Witherington and Martin, 2003; Pendoley & Kamrowski, 2015; Kamrowski, et al., 2014). Hatchlings may become disorientated - where hatchlings crawl on circuitous paths; or mis-orientated - where they move in the wrong direction, possibly attracted to artificial lights (Withington and Martin, 2003; Lohmann et al., 1997; Salmon 2003). Hatchling orientation has been shown to be disrupted by light produced at distances of up to 18 km from the nesting beach (Hodge et al. 2007, Kamrowski et al.

2014), although the degree of impact will be influenced by a number of factors including light intensity, visibility (a function of lamp orientation and shielding), spectral power distribution (wavelength and colour), atmospheric scattering, cloud reflectance, spatial extent of sky glow, duration of exposure, horizon elevation and lunar phase. Hatchlings disoriented or misoriented by artificial lighting may take longer, or fail, to reach the sea. This may result in increased mortality through dehydration, predation or exhaustion (Salmon and Witherington, 1995).

Hatchling Dispersal

Once in nearshore waters, artificial lights can also interfere with the dispersal of hatchlings. Presence of artificial light can slow down their in-water dispersal (Witherington & Bjorndal, 1991; Wilson et al., 2018), increase their dispersion path, potentially depleting yolk reserves, or even attract hatchlings back to shore (Truscott et al., 2017). In addition to interfering with swimming, artificial light can influence predation rates, with increased predation of hatchlings in areas with significant sky glow (Gyuris 1994; Pilcher et al 2000). Since the nearshore area tends to be predator-rich, hatchling survival may depend on them exiting this area rapidly (Gyuris, 1994). Should this be the case, aggregation of predatory fish occurring in artificially lit areas (e.g. Wilson et al., 2019) may further increase predation of hatchlings.

An internal compass set while crawling down the beach, together with wave cues, are used to reliably guide them offshore (Lohmann & Lohmann 1992, Stapput & Wiltschko 2005; Wilson et al, submitted).

In the absence of wave cues however, swimming hatchlings have been shown to orient towards light cues (Lorne & Salmon 2007, Harewood & Horrocks 2008) and in some cases, wave cues were overridden by light cues (Thums et al. 2013; 2016; Wilson et al., 2018).

The speed and direction of at-sea dispersal is substantially influenced by currents; the offshore trajectory of flatback hatchlings at Thevenard Island was displaced by tidal currents that ran parallel to the beach, an effect that increased as the hatchlings moved further offshore (Wilson et al. 2018, 2019). However, when light was present this effect was diminished, showing that hatchlings actively swam against currents and towards the light source, which slowed their offshore dispersal from 0.5 m/s^{-1} when no light was present, to 0.35 - 0.44 m/s^{-1}, depending on the type of light (Wilson et al., 2018). Wilson et al (2018) demonstrated that when flatback hatchlings were within 150 m of the beach, they were able to swim against currents up to 0.3 m/s^{-1}.

These results suggest that hatchlings can move in any direction when their swimming speed is greater than the speed of the nearshore current, although the speed at which currents can no longer be overcome by hatchlings will be species specific and related to swimming speeds.

In the event that hatchlings are able to swim against current speeds, there is a risk that they could become entrapped in areas of light spill.

Given the proximity, the greatest potential for lighting impacts to marine turtles from Pluto is located at the adjacent Holden Beach. Albeit not a significant turtle rookery, a monitoring program commensurate with the nature and scale of the risk has been developed (refer to Section 5).

New and existing sources of lighting at Pluto will contribute to sky glow within the region. This additional light is in the context of a highly trafficked international port and industrial zone as per the light sources described in Table 9. Although ambient light monitoring within the Dampier Archipelago has not been undertaken, existing light pollution in this area is expected to be high (DoEE, 2017).

Based on a potential impact radius within 18 km of the facility, there are a number of islands identified as nesting BIAs and/or habitat critical. Based on turtle track data, only very low nesting activity is expected within this area, with the exception of Angel Island where hawksbill and flatback track counts in the order of 1-10 per day have been recorded (Pendoley et al., 2016). Sky glow at significant distances from major receptors is highly unlikely to affect nesting females given their reduced sensitivity to light cues, and unlikely to affect dispersing hatchlings where the predominant ocean currents are directed away from the facility and any attraction to cumulative light sources on the Burrup Peninsula will be temporary and resolve upon sunrise. Given the distance (>25 km) from major rookeries such as Delambre, Rosemary and Enderby islands, impacts to emerging hatchling populations from sky glow are highly unlikely.

Table 13 and **Table 14** summarise the subsequent actions that will be implemented if evidence of turtle disorientation resulting from onshore lighting from Pluto LNG (Foundation or Expansion) is recorded. The adaptive management framework that would apply for both operational and construction phases of the project is shown in **Figure 6**.

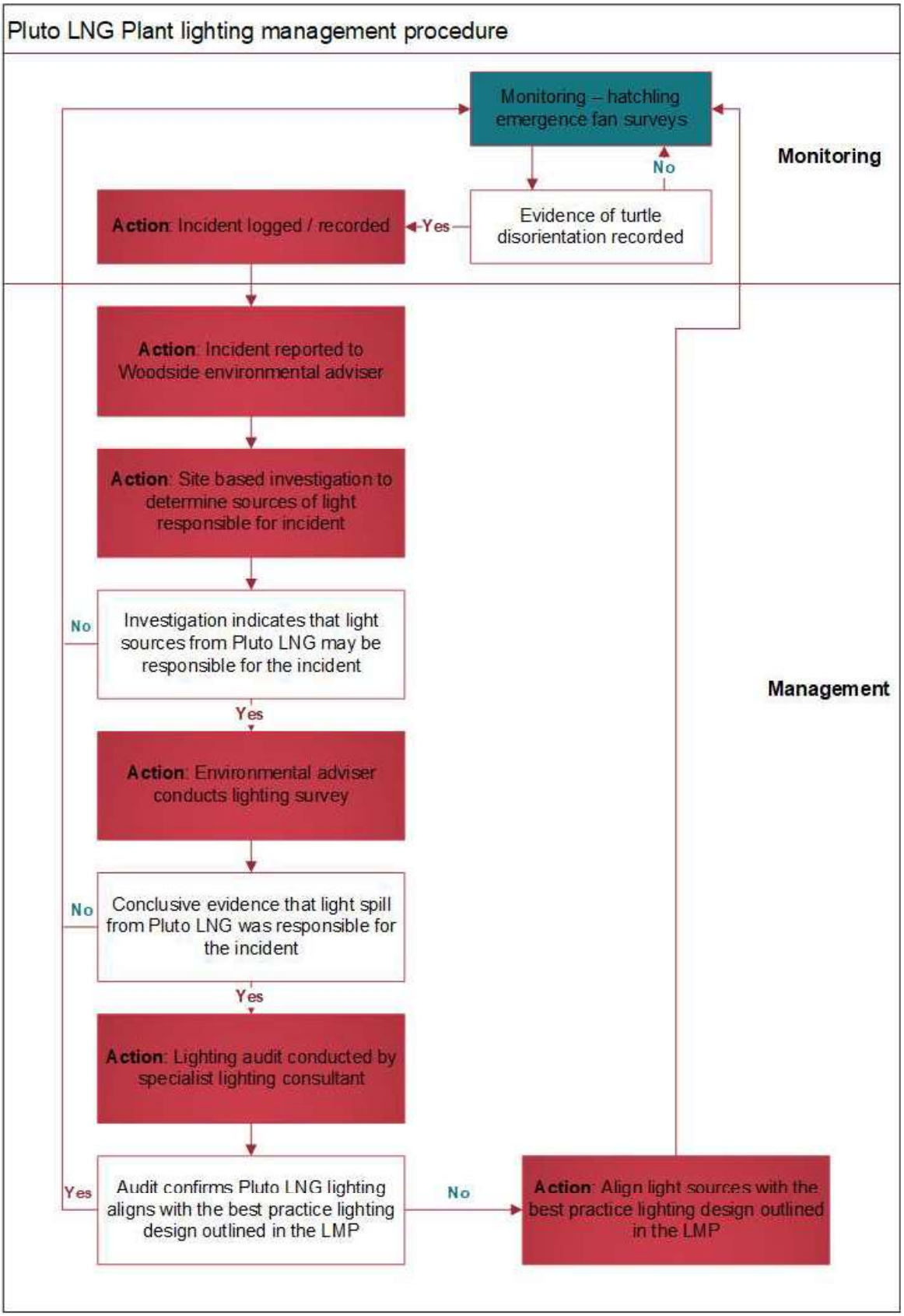

Figure 6 – Pluto LNG lighting management procedure

4.3 Stressor OS4 – Dredging and Spoil Disposal Procedure

As identified in Section 2.1.1, the nesting periods for the 'habitat critical' for internesting flatback, green and hawksbill turtles around the Dampier Archipelago is:

- Flatback turtles – October to March;
- Green turtles – November to March; and
- Hawksbill turtles – October to February.

Therefore, the peak sea turtle breeding and nesting season around the Dampier Archipelago occurs within a 6-month period from October to March.

Unplanned maintenance dredging operations associated with Pluto LNG Operations are most likely to be required due to sediment infill of the shipping channel for Pluto LNG as a result of cyclonic activity. The most active months for tropical cyclones in the Pilbara region are mid-December to April with an average frequency of two cyclones per year crossing the Pilbara coast. Accordingly, maintenance dredging activities may overlap the peak sea turtle breeding and nesting season around the Dampier Archipelago.

For maintenance dredging planned for reasons other than responding to emergency situations such as cyclones, timeframes will be evaluated to avoid coinciding with peak turtle nesting and breeding season, as outlined in OS4, Table 13.

In advance of future maintenance dredging activities (related to Pluto Foundation), the dredge vessel crew will receive training from a qualified marine fauna observer (MFO). In the absence of a MFO, the vessel captain will be responsible for logging sighting and sea turtle injury/death reporting by the crew. These procedures must be followed as part of any maintenance dredging (**Figure 7**) and spoil disposal (**Figure 8**) procedure.

A turtle/marine mammal watch will be maintained at all times from all dredging and dredge support vessels. Should any marine fauna (turtle, dolphins, dugongs, whales) be sighted, all dredging vessels operating in the area shall be notified. Fauna presence, including direction and behaviour will be monitored and dredging equipment kept well clear. Sighting of sick or injured turtles will be reported to the regional Department of Biodiversity, Conservation and Attractions office. These incidences will be recorded using the sea turtle incident form contained in Appendix C.

It is noted that the dredging procedure (**Figure 7**) identifies a 20 m exclusion zone to be maintained for sea turtles and marine mammals in the event that animals are identified within 50 m of the vessel. Application of the 20 m exclusion zone with respect to dolphins is not considered feasible. Dolphins are unique in that they:

- are relatively common in the work area;
- are known to be attracted to dredging activities due to foraging potential created by disturbance of the seabed;
- frequently "bow ride" on small and large vessel when moving at speeds greater than 4 knots;
- are intelligent;
- are extremely manoeuvrable and are capable of outpacing a working CSD or TSHD; and
- have excellent navigational abilities (echolocation).

As such, the response to a dolphin within 20 m of any dredging vessel will be gauged on the behaviour of that individual. This will include an assessment of whether the animal is showing a tendency or persistence to enter and remain in high risk areas (such as in close proximity to drag and cutter heads). An animal that is tracking across the 20 m radius at speed, or bow riding will not trigger a stop dredge response (bow riding animals will be managed in accordance with the Australia National Guidelines for Whale and Dolphin Watching). This procedure will be evaluated on an ongoing basis by the MFO.

In addition to the procedures described above, turtle exclusion devices and methods will be implemented, the application of which, being dependent on the particular dredging situation. The following exclusion devices would be used for the TSHD in the appropriate situations:

- In areas where an under keel clearance for a loaded dredge is in excess of 4 m, sea turtle deflection devices constructed of chains will be fitted to the trailing pipe forward of the draghead on the TSHD. These deflectors will be similar to those used on previous dredging projects within Western Australia.
- In areas where the TSHD are operating with less than 4 m under keel clearance (loaded vessel), the use of deflector devices would affect the steering and propulsion of the vessel, thereby presenting an unacceptable safety risk. In addition, the deflector devices would drag along the seabed rendering them ineffective. When dredging in these areas, the dredge will move slowly through the area before commencing dredging to allow time for the pressure pulse, noise and vibration to encourage any sea turtles to leave the vicinity. This will be done on the first few passes when dredging in virgin material and not on every pass once a work area has been established, with the under keel clearance measurement based on the level at lowest astronomical tide (LA). This is based on a number of factors:
  - In Mermaid Sound, turtles are not known to concentrate in substantial numbers through depressions and channels like as in other parts of the world (i.e. United States of America, USA).
  - In these shallow areas (less than 4 m under keel loaded clearance at Lowest Astronomical Tide (LAT), when fully loaded) the dragheads are typically positioned some 70-100 m behind the bow of the dredge. At the typical dredging speed of 1.5 to 2.5 knots, the hull provides a significant “pressure pulse wave” over an area where turtles may have settled well in advance of the passing dragheads. In addition the general noise generated by the dredge pumps running, the bow will also pass over such an area well before the dragheads do, thereby adding further warning to any turtles in the area.
- In areas where the under keel clearance is in excess of 4 m (i.e. the pressure pulse will be ineffective) and the material to be dredged consists of compacted sand or gravel, the draghead jets will be used to deter turtles from the draghead. The jets will be operated by a pass over of the areas prior to dredging. This method is not feasible during the dredging of low density / high moisture content material as the jets will increase sedimentation, increasing the intensity and duration of impact caused by the dredge plume.
- Within the requirements of the dredging operations, the dredge pumps will be turned off as soon as practically possible after the draghead clears the bottom on completion of the dredging cycle.

As CSDs and BHDs occupy a much smaller “static” work area (relative to a TSHD), different management measures would be utilised, should these vessels be required. Should operations with a BHD be required, operations would stop if a sea turtle or marine mammal entered the 20 m radius as per above. However, it is not possible to stop a CSD abruptly due to the mass and momentum of the dredge. Such a sudden stoppage

may result in damage to the ladder and cutter head. For a CSD, the same establishment procedures as described above (300 m radius) would be implemented when starting / restarting works and the 50 m watch will be maintained (50 m from cutter head). Should a sea turtle be observed within a 20 m radius of the dredge, the dredge would stop swinging and the ladder would be lifted so the cutter is clear of the sea bed and the cutter blade disengaged. The dredge pumps will continue to prevent blockages of the dredge pumps and pipelines. Should the animal(s) remain within close proximity of the cutter head (i.e. within 20 m) the pumps will be slowly shut down once the dredge pumps and pipelines are cleared of dredge material.

DWER will be notified when any maintenance dredging programs are scheduled to be undertaken.

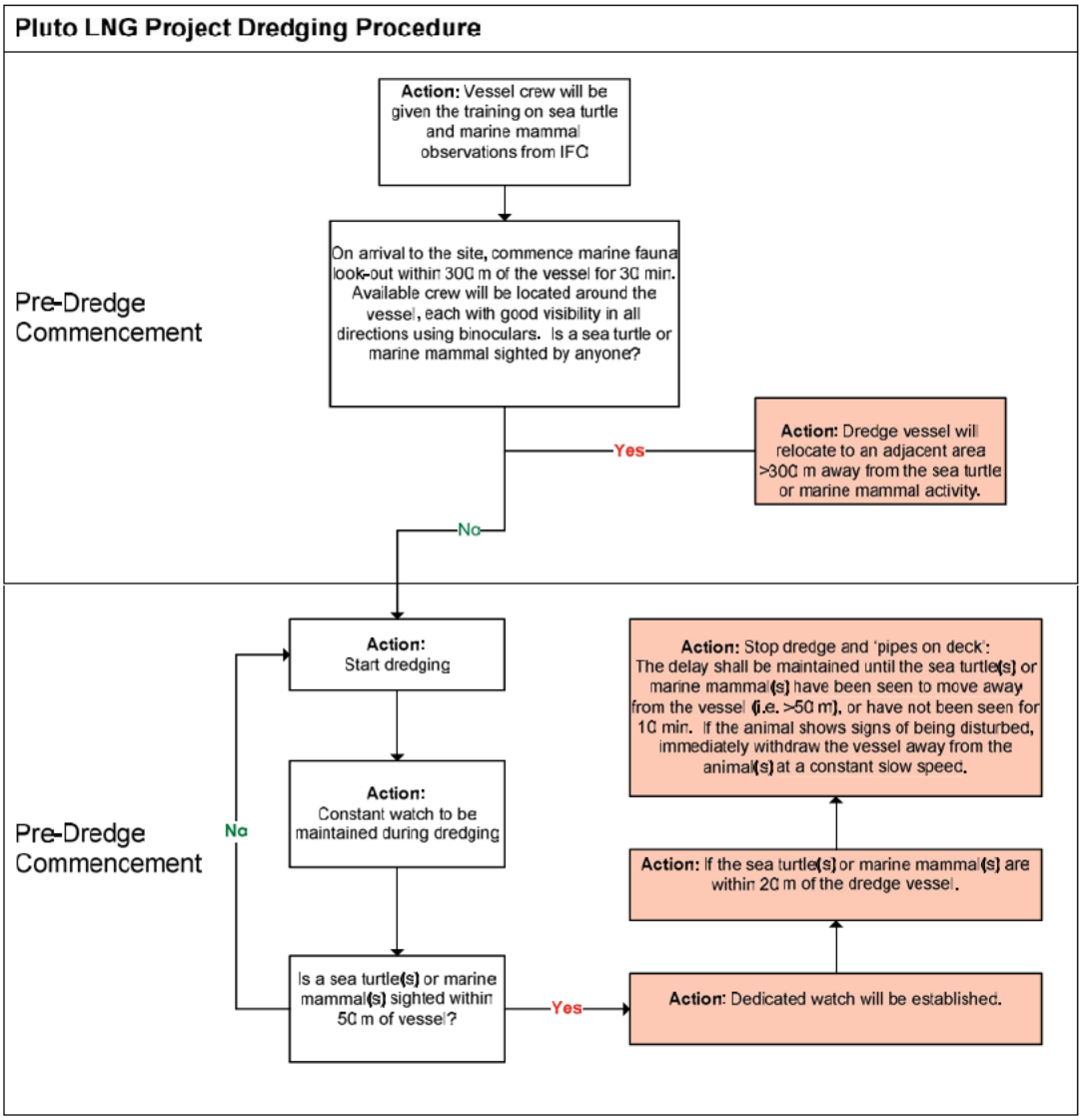

Figure 7 - Maintenance Dredging Procedure

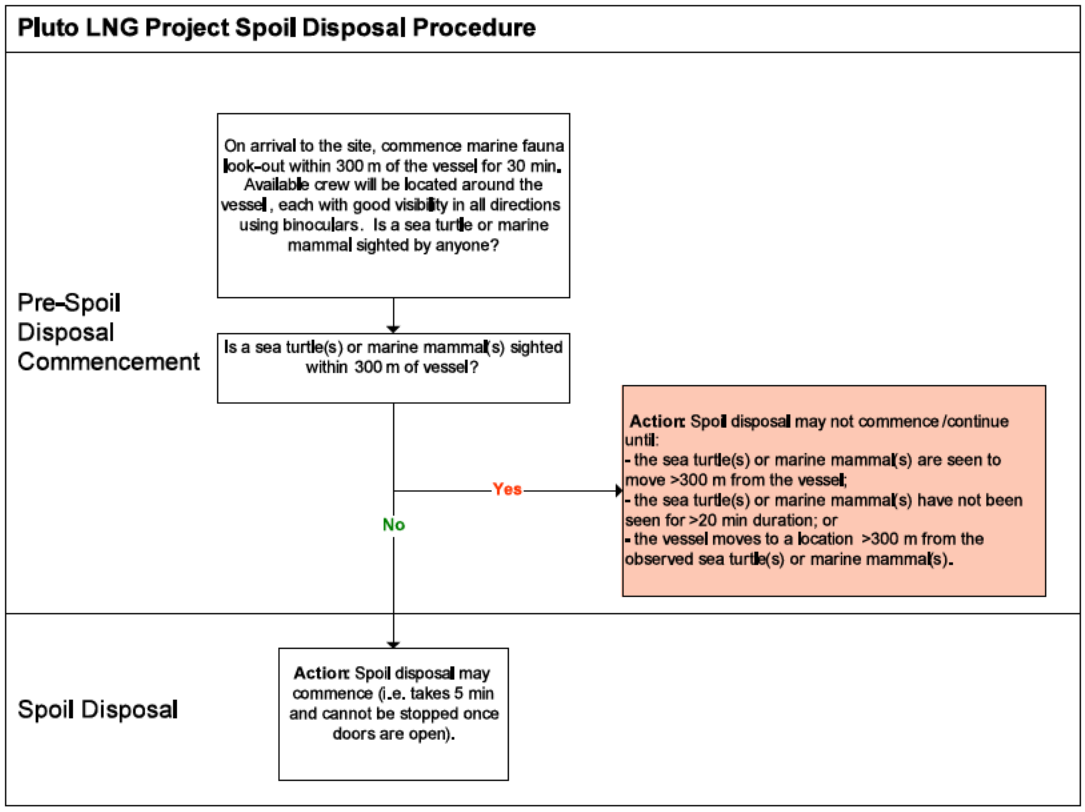

Figure 8 - Dredge Spoil Disposal Procedure

4.4 Contingency Actions

Woodside recognises that contingency measures and adjustments to management strategies may be required in the event adaptive management is required, as triggered by the process outlined above (Sections 4.2, 4.3). New mitigation measures will be discussed with the DWER, (DCCEEW and DBCA additionally as required) prior to implementation.

5. Monitoring

5.1 Pluto Foundation Construction Phase Monitoring

As described in Section 2.2.1, an initial baseline monitoring program of sea turtle monitoring was undertaken in 2005 - 2007 nesting seasons.

Subsequently, in accordance with the commitment made in the original STMP (Rev 0), a sea turtle monitoring program for Holden Beach was undertaken for five years from Pluto Foundation start-up (i.e. until 2016).

The goals of the first phase of monitoring were:

- detection of trends over time relating to turtle nesting (i.e. frequency); and
- investigation on whether potential light-related impacts are affecting nesting and hatchling behaviour.

Results of this monitoring are presented in Section 2.2.3. This program has now concluded, and following consultation with the Department of Biodiversity, Conservation and Attractions an ongoing monitoring program (described in Section 5.2) has been developed for the operations phase.

As with the monitoring undertaken during construction of the initial site infrastructure within Site A (as part of the approved Pluto LNG Project), operational monitoring involved the recording of sea turtle tracks. This occurred (until 2016) from September to May, thereby coinciding with the flatback, green and hawksbill nesting period. Track photographs were taken, to assist in the identification of sea turtle species, and records taken of any nesting attempts (as represented by a body pit). GPS locations were also taken of both turtle tracks and body pits.

Monitoring was planned to best consider factors such as number of nests, incubation duration, and forecast wind and rain events. During likely hatching periods, monitoring for weather events optimised the ability to observe and record hatchling tracks.

Nest fan measurements assisted in identifying the movements of hatchlings from light during their sea-finding behaviour, as well as confirming actual nesting activity on Holden Beach. Measurements, including hatchling emergence date, GPS location, fan heading, fan spread and fan offset were taken.

Monitoring was undertaken by a suitably trained person, coordinated by the Environmental Adviser.

5.2 Ongoing Monitoring Plan (i.e. Pluto Operations and proposed future construction)

Ongoing monitoring of turtle activity on Holden Beach as described in **Table 15** will be undertaken to detect potential impacts on marine turtles from the project, in accordance with Condition 9 of MS 757. The ongoing monitoring plan has been developed in consultation with DBCA.

5.2.1 Monitoring Method

There are five monitoring methods used in the turtle monitoring program:

- ‘Morning After’ beach surveys;
- Hatchling Emergence Fan Survey;

- Construction Lighting Monitoring;
- Lighting Surveys/Monitoring; and
- Five (5) yearly Lighting Audits.

These monitoring methods are aligned with the best-practice standards described in Appendix F of the National Light Pollution Guidelines (Commonwealth of Australia, 2020).

Table 15 - Turtle Monitoring Methods at Pluto LNG

Monitoring	Methodology	Objectives	Parameters	Monitoring Frequency
'Morning After' beach survey	Collection of nesting and incubation data. North West Shelf Flatback Turtle Conservation Program – Turtle Monitoring Field Guide – 2nd Edition, chapter 3. Record keeping of data obtained during beach surveys is aligned with chapter 4 of the Ningaloo Turtle Program Monitoring Field Guide – edition 7, treating Holden Beach as a continuous beach subsection.	To determine nesting activity on Holden Beach	• the total number of body pits per species and a GPS location for each one; • the number of suspected successful nests per species and a GPS location for each one; • the number of false crawls per species; • the number and location of disturbed nests; • potential causes of nest disturbance; • presence of predators; and • the number of hatched nests.	Beach surveys are undertaken fortnightly from 1 September, until the first turtle activity is recorded. Following this, beach surveys are undertaken once per week. Weekly monitoring will continue until 1 March, or until the incubation period of the last potential nest has exceeded 70 days, or the nest has hatched, whichever is later. Historically, no nesting activity has occurred after February on Holden Beach. Additional surveys will be undertaken where practicable before predicted adverse weather events such as periods of cyclones and tropical lows to ensure that evidence of nesting or hatchling emergence is not eroded prior to scheduled monitoring event.
Hatchling emergence	Measures of orientation of hatchling tracks on Holden Beach. Refer to Section 5.2.1.1 for details on methodology [Pendoley (2005) and Salmon and Witherington (1995)].	To determine hatchling disorientation following emergence form the nest	• hatchling emergence fan spread • hatchling emergence fan offset angles (from most direct line to the ocean)	Monitoring frequency is conducted in line with 'Morning After' beach survey, until the last potential nest has hatched, or until incubation period of the last potential nest has exceeded 70 days. Since monitoring commenced in 2007 the maximum incubation period is 66 days at Holden Beach.
Construction Lighting Monitoring	The Construction Contractor conducts a check of anthropogenic light sources at the construction site and ensure compliance with the	To identify any non-compliances from the project specific Light Management Plan.	• verification that the requirements of Construction Light Management Plan are being implemented.	Monthly during construction phase of Pluto Expansion.

Monitoring	Methodology	Objectives	Parameters	Monitoring Frequency
	project specific Light Management Plan.			
Lighting survey from Holden Beach	The Woodside Environmental Adviser conducts a check of anthropogenic light sources to Holden Beach at night	To identify any deviations from the LMP.	• verification that turtle lighting minimisation measures as per the LMP have been activated by 1st September each season. • a survey to identify any additional sources of light within the light management zones and if present, ensure compliance with LMP.	Annually, at the beginning of each season (prior to hatching emergence).
Lighting Audit	Audit by a specialist lighting consultant on the implementation of the LMP	To identify any deviations from the LMP.	• a survey to identify and confirm any additional sources of light within the light management zones. • if new sources are present, ensure compliance with LMP.	Five yearly frequency has been underway during the Operations phase of the Pluto Foundation Project. The five-yearly frequency will re-start following completion of Pluto Expansion, and continue every five years following.

5.2.1.1 *'Morning After' Beach Surveys*

Monitoring of turtle activity is based on the standard 'morning after' beach survey technique (IUCN/SSC Marine Turtle Specialist Group 1999, SWOT handbook) outlined in chapter 3 of the North West Shelf Flatback Turtle Conservation Program – Turtle Monitoring Field Guide – 2nd Edition.

Suitably trained personnel (see Section 5.2.3) will walk the extent of Holden Beach using a handheld GPS, camera, tape measure, compass and clipboard or the *DBCA Marine Science Program* turtle field data collection application on a tablet to record:

- the total number of body pits per species and a GPS location for each one;
- the number of suspected successful nests per species and a GPS location for each one;
- the number of false crawls per species;
- the number and location of disturbed nests;
- potential causes of nest disturbance;
- presence of predators; and
- the number of hatched nests.

Record keeping of data obtained during beach surveys is aligned with chapter 4 of the Ningaloo Turtle Program Monitoring Field Guide, treating Holden Beach as a continuous beach subsection (Note: equivalent information is not provided in the North West Shelf Flatback Turtle Conservation Program – Turtle Monitoring Field Guide – 2nd Edition).

5.2.1.2 *Hatchling Emergence Fan Survey*

When a hatched nest is identified during beach surveys, data on hatchling emergence fans are also collected as part of ongoing monitoring. The method for collecting and analysing this data was adapted from Pendoley (2005) and Salmon and Witherington (1995).

The two parameters used to determine hatchling disorientation are fan spread and offset angles. The compass bearings collected during surveys to determine these parameters include (see **Figure 9**):

- compass bearings on either side of the furthest right and left hatchling tracks, taken from the nest to the Census Line (A and B Bearings in **Figure 9**);
- compass bearing for the most direct route to the ocean, taken from the nest to the Census Line (X Bearing in **Figure 9**); and
- compass bearings from the nest to anthropogenic light sources (Flare and Jetty Bearings in **Figure 9**).

This data is used to calculate the following:

- Fan spread, which is the angle between A-B Bearings.
- Fan angle midpoint, which is the midpoint between A-B Bearings.
- Offset Angles, which are the angles between the fan angle midpoint and
    1. the X Bearing (X offset angle);
    2. the Jetty Bearing (Jetty offset angle); and
    3. the Flare Bearing (Flare offset angle).

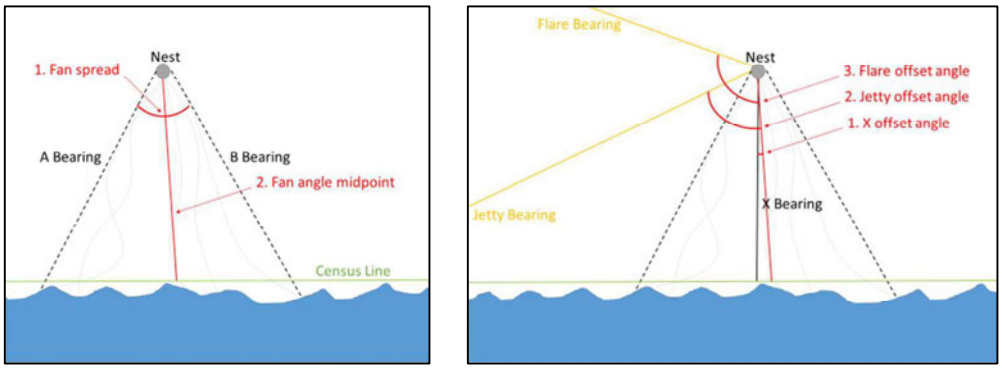

Figure 9 - Illustration of fan spread and offset angle parameters for hatchling emergence fan survey

To determine hatchling orientation, the smallest offset angle can be used to infer the most influential navigation aid used by the hatchlings. If the smallest angle is the X offset angle then it can be concluded that there was no significant influence from the identified anthropogenic light sources (as shown in **Figure 10**(1) and **10**(2)). Alternatively, if the smallest angle is either the jetty or the flare offset angles, there is evidence that these light sources are significantly influencing the hatchling's navigation (as shown in **Figure 10**(3) and **10**(4)).

Figure 10 outlines the main scenarios that may occur from the described hatchling emergence fan surveys: the top-left illustrates a scenario where there is no evidence of disorientation or influence from anthropogenic sources; the bottom-left figure illustrates evidence or disorientation, however, with no apparent influence from the identified anthropogenic light sources; the top and bottom figures on the right show influence from the jetty anthropogenic light source, with both small and large fan spread angles. In both these cases, it would be considered that there was an incident or hatchling turtles being disoriented by light associated with Pluto LNG and proceeding actions would be triggered (refer to Performance Management Targets in **Table 13** and **Table 14**.

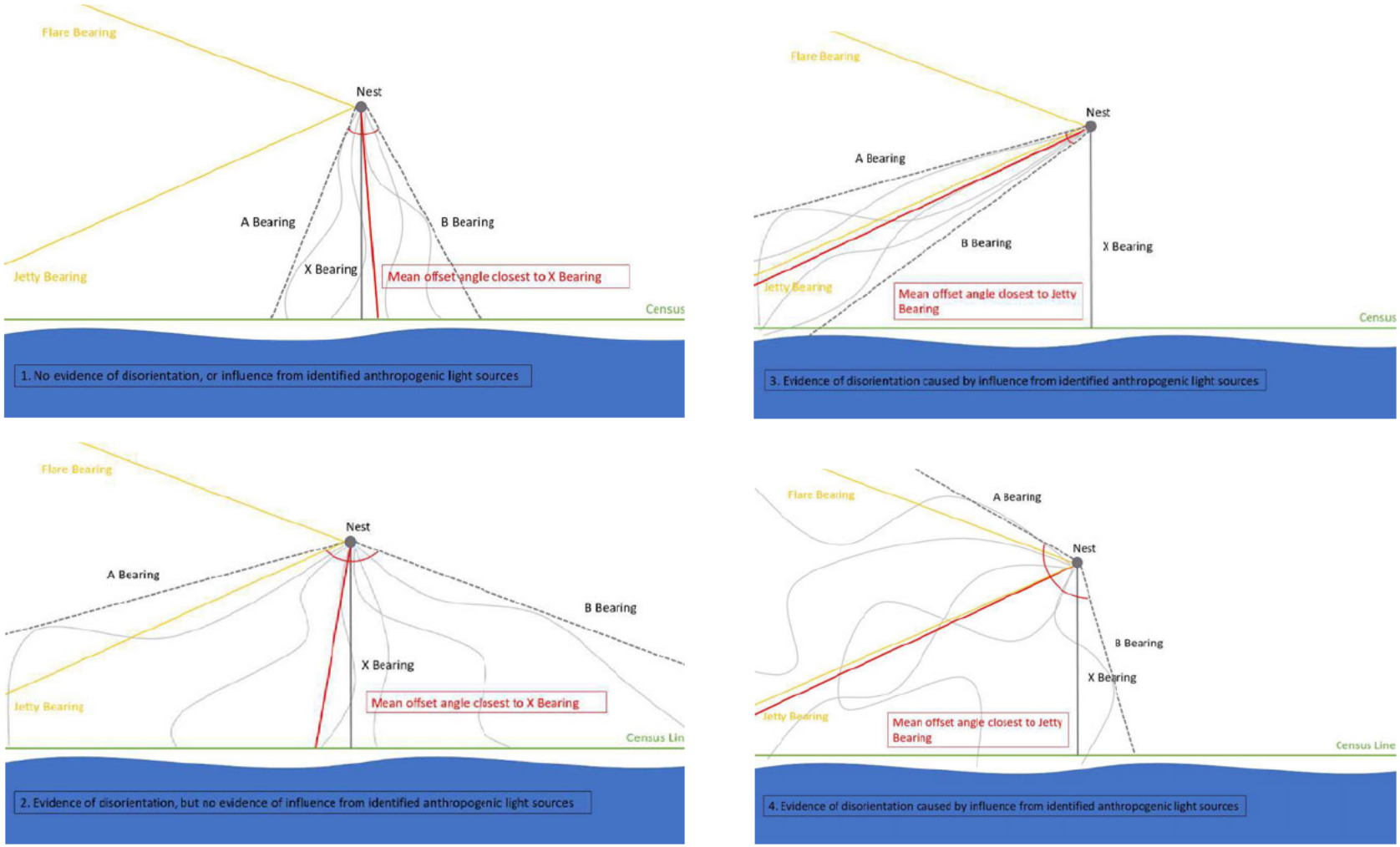

Figure 10 - Hatchling emergence fan survey decision criteria (top-left: no disorientation or anthropogenic influence; bottom-left: evidence of disorientation, but no anthropogenic influence; top and bottom right: evidence of disorientation caused by anthropogenic influence).

5.2.1.3 Annual Lighting Survey

In addition to the five yearly audits against the LMP undertaken by a specialist consultant, at the beginning of each season (prior to hatching emergence) the Pluto Environment Adviser conducts a check of anthropogenic light sources to Holden Beach at night, to identify any deviations from the LMP. The check will involve:

- Verification that turtle lighting minimisation measures as per the LMP have been activated by 1 September each season; and
- a survey to identify any additional sources of anthropogenic light from Pluto construction or operations within the light management zones. Where additional sources of anthropogenic light are present, ensure compliance with the LMP.

5.2.2 Frequency

Beach surveys are undertaken fortnightly from 1 September, until the first turtle activity is recorded. Following this, beach surveys are undertaken once per week. Weekly monitoring will continue until 1 March. Additional surveys will be undertaken where practicable before predicted adverse weather events such as periods of cyclones and tropical lows to ensure that evidence of nesting or hatchling emergence is not eroded prior to scheduled monitoring event.

Evidence from the first phase of turtle monitoring on Holden Beach suggests that turtle tracks remain clear for an extended period and weekly monitoring is adequate to identify all tracks, including hatchling emergence fans. **Table 16** shows the degradation of a set of tracks over time, indicating that deterioration is limited over 14 days (note the following reference points (1) census cut line crossing the tracks and (2) vegetation in the top right-hand corner of the photographs). The third photograph in the table highlights that even after over 25 days, the same tracks are still easily identifiable as turtle tracks. This is due to the sheltered nature of the beach and access to the beach being prohibited apart from specially authorised personnel.

Table 16 - Degradation of turtle tracks on Holden Beach over one time

		
Photograph 1: taken 29/12/17	Photograph 2: +14 days	Photograph 3: +25 days

5.2.3 Training and Competency

Monitoring will be undertaken (or led) by personnel with appropriate training under the North West Shelf Flatback Turtle Conservation Program – Turtle Monitoring Field Guide – 2nd Edition.

5.2.4 Monitoring during Expansion activities

Assessment of the potential impact from Pluto Expansion indicates no significant impact expected on sea turtle nesting activities on Holden Beach.

Woodside's monitoring program during Pluto Expansion activities will be implemented as outlined in **Table 15**.

5.3 Maintenance Dredging

As part of any future maintenance dredging and spoil disposal, sea turtle observations will be recorded in a daily log book. The vessel captain will be ultimately responsibility for ensuring these observations are made and recorded in the vessel log.

Prior to commencement of these activities, fauna spotters will be identified and briefed by the Woodside Environmental Adviser to ensure observational and reporting requirements are understood. It would be expected that individual turtle sightings be recorded; however, species identification will not be required. In instances where the MFO is on board, the responsibility for recording observations will default to the MFO.

6. Reporting

6.1 Routine and Non-Routine Reporting

Monitoring of the Sea Turtle Management Plan will be achieved through the compilation of monitoring records. Any incident that results in a sea turtle injury or fatality will be recorded on Accident, Injury and Incident Reports (Appendix C). **Table 17** describes the reporting requirements relevant to the STMP.

Turtle observation data will be compiled by the Woodside Environmental Adviser and a Turtle Monitoring Report sent by 30 April each year to the DBCA and DCCEEW.

Reports shall be provided in an electronic format.

In the event of a turtle or marine mammal injury/death associated with Pluto LNG, it will be reported to the Woodside Environment Adviser who will report the incident to DBCA and DCCEEW (**Table 17 -** below). An investigation will be initiated to determine the cause of the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.

In the event that evidence of turtle disorientation resulting from Pluto LNG is recorded, investigation will be undertaken to determine the source(s) of light responsible for the incident and to identify and consider potential additional controls/mitigation measures that should be implemented.

Table 17 - STMP Reporting Requirements

Reporting Type	Report to	Timing	Responsibility
Routine			
Turtle observation data	DCCEEW P: 02 6274 2942 F: 02 6274 1878 E: PostApproval@environment.gov.au	Annually by 30 April	Woodside Site Environment Adviser
	DBCA P: 08 9182 2000 (business hours); 08 9182 2088 (after hours) F: 08 9144 1118 E: Karratha.admin@dbca.wa.gov.au and fauna@dbca.wa.gov.au		
Non-routine			
Any incident that involves the injury or mortality of a sea turtle or marine mammal will be reported. Details of the incident, including time and date of incident, cause of injury/mortality and the species (if known) will be recorded and reported.	DBCA	Within 24 hours following observation	Maintenance Dredging – Woodside Project Rep Operations – Site Environment Adviser
	DCCEEW	Within 24 hours following observation	

6.2 Organisation

Responsibility for implementation of the STMP resides with Woodside Burrup Pty Ltd as operator of Pluto LNG. Responsibility for meeting any reporting requirements to the statutory organisations will remain with Woodside.

There will be a Construction Contractor for Construction Phase of the Pluto Expansion Project that will be responsible for reporting incidents/observations to Woodside relating to the STMP. These will be reported in a timely manner so regulatory reporting timeframes can be met.

Figure 11 shows the reporting structure for turtle incidents and observations during operations.

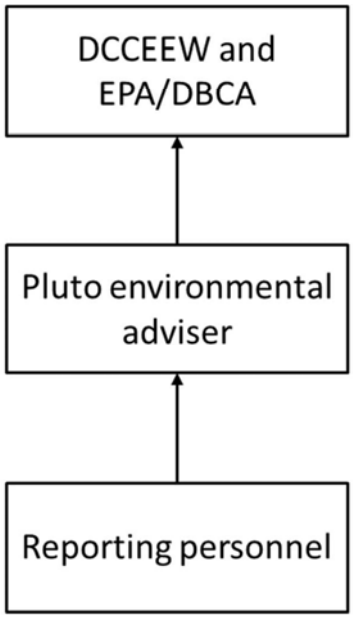

Figure 11 - Recommended Reporting Line of turtle incidents/observations for Pluto LNG Operations

Figure 12 shows the reporting structure during maintenance dredging.

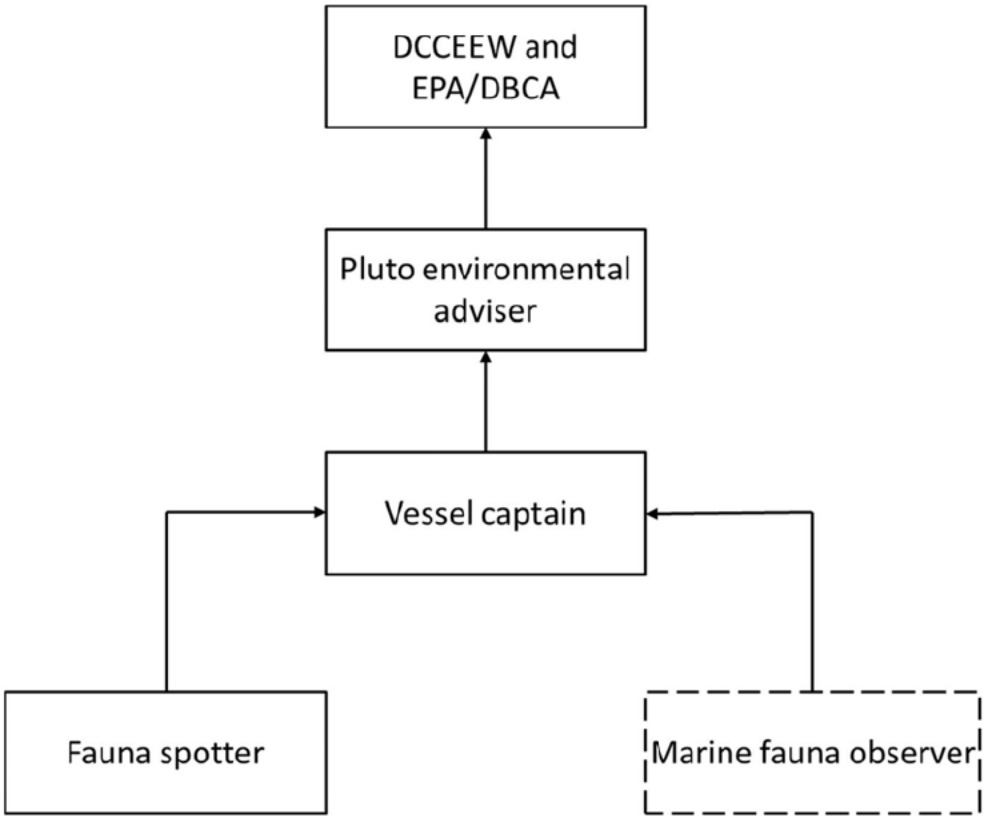

Figure 12 - Recommended Reporting Line for Outcomes of the Turtle Monitoring Program during Maintenance Dredging activities ***Note - The MFO is a temporary position and would only be required based on the requirements outlined in Section 4.2.***

6.3 Roles and Responsibilities

6.3.1 Operations

The Pluto Asset Manager is responsible for ensuring implementation of those aspects of this plan relevant to onshore Operations, and will be supported by the Environmental Adviser in delivery of the onshore aspects of this plan. **Table 18** shows responsibilities under this STMP for the Operations Phase.

Table 18 - STMP Responsibility Matrix for Personnel in the Operations Phase

Role	Responsibility
Pluto Asset Manager	■ Ensures the project compiles with legal conditions and commitments, including with the LMP. ■ Ensures implementation of Sea Turtle Management Plan.
Pluto Environmental Adviser	■ Co-ordinates environmental aspects of onshore works (i.e. nearshore turtle monitoring at Holden Beach/ nearshore). ■ Provides fauna training to new Environment Site Adviser ■ Assists with fauna observations. ■ Undertakes monitoring in line with Table 15 ■ Provides input into inductions on fauna observations. ■ Notification to regulators of regulatory reportable incidents.
All personnel	■ Receive site induction, including relevant environmental requirements (i.e. fauna interaction and sensitive habitat locations).

6.3.2 Pluto Expansion - Construction Phase

The Woodside Construction Manager is responsible for ensuring implementation of those aspects of this plan relevant to onshore construction activities. The Construction Manager will be supported by the Environmental Adviser - Onshore works in delivery of the onshore aspects of this plan. **Table 19** shows responsibilities under this STMP for the Construction / Expansion phase.

Table 19 - STMP Responsibility Matrix for Personnel in the Construction / Expansion Phase

Role	Responsibility
Woodside Construction Manager	• Ensures the project complies with legal conditions and commitments, including the Train 2 project specific Light Management Plan. • Ensures implementation of the STMP.
Environmental Adviser - Onshore works	• Co-ordinates environmental aspects of onshore works (i.e. nearshore turtle monitoring at Holden Beach/ nearshore). • Assists with marine fauna observations. • Provides input into inductions on marine mammal and sea turtle management and commitments. • Notification to regulators of regulatory reportable incidents.
Construction Contractor	• Responsible for reporting incidents/observations to Woodside relating to the STMP. These will be reported in a timely manner so regulatory reporting timeframes can be met.
All personnel (WEL and Construction Contractor)	• Receive site induction, including relevant environmental requirements (i.e. marine mammal and sea turtle management and commitments and sensitive habitat locations).

6.3.3 Maintenance Dredging

The Woodside representative and vessel captain are ultimately responsible for ensuring the accurate reporting of any observations or incidences involving turtles. However, there will also be an MFO on dredge vessels, where maintenance necessitates further dredging works, responsible for training, logging and reporting turtle observations and incidents. The MFO will be independent of the day to day dredging operations ensuring that an objective review process is undertaken. The MFO may be a Woodside staff member, who is not directly affiliated with required dredging activities.

An outline of roles and accountabilities for personnel are detailed in **Table 20.**

Table 20 - STMP Responsibility Matrix for Personnel in the Implementation Phase (Maintenance Dredging)

Role	Responsibility
Maintenance and Operations Managers	• Ensures the project compiles with legal conditions and commitments.
Woodside Dredging (site) representatives	• Ensures implementation of Dredge Spoil Disposal and Sea Turtle management plans. • Ensure implementation of dredging commitments.
Site Environmental Adviser - Dredging	• Co-ordinates environmental aspects of dredging and disposal. • Assists with fauna training and observations. • Provides input into inductions on fauna observations. • Notification to regulators of regulatory reportable incidents.
Site Environmental Adviser - Onshore works	• Co-ordinates environmental aspects of onshore works (i.e. nearshore turtle monitoring at Holden Beach/ nearshore). • Assists with fauna training and observations.

	• Provides input into inductions on interactions with fauna and sensitive habitat locations.
Vessel Captain(s)	• Responsible for ensuring accurate reporting of marine fauna observations and incidents.
Fauna Spotters	• Operations crew trained in fauna observations by the environmental adviser, responsible for conducting and reporting Holden Beach monitoring during operations. • Maintenance crew trained in fauna observations by the MFO, responsible for conducting and reporting fauna observations during dredging
Marine Fauna Observer (MFO)	• Provide training to allocated fauna spotters in fauna observations. • Provides input into inductions on fauna observations. • Provides independent review of fauna observations during peak nesting period. • Provides independent review of Holden Beach turtle monitoring program.

6.4 Annual Review

This STMP will be reviewed and submitted to relevant regulatory bodies on an annual basis to ensure conditions and objectives outlined in Section 1.4 of this Management Plan are being met. A review process will be initiated following a sea turtle/marine mammal incident, in accordance with the adaptive management framework outlined in Sections 4.2 and 4.3. This may involve an update to either the STMP or the LMP, or both.

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APPENDIX A: Woodside Risk Matrix

Consequence

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

Likelihood

	Remote	Highly Unlikely	Unlikely	Possible	Likely	Highly Likely
Experience	Unheard of in the industry	Has occurred once or twice in the industry	Has occurred many times in the industry but not at Woodside	Has occurred once or twice in Woodside or may possibly occur	Has occurred frequently at Woodside or is likely to occur	Has occurred frequently at the location or is expected to occur
Frequency	1 in 100,000 - 1,000,000 years	1 in 10,000 - 100,000 years	1 in 1,000 - 10,000 years	1 in 100 - 1,000 years	1 in 10 - 100 years	> 1 in 10 years
Modelled distribution %* (Probability of event occurrence)	< 1%	1% - 5%	6% - 20%	21% – 50%	51% - 80%	> 80%
LEVEL	0	1	2	3	4	5

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

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

Risk endorsement table

Current Risk

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

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

APPENDIX B: Pluto Light Management Plan (LMP)

DRIMS# 8019892

APPENDIX C: Turtle Accident, Injury and Incident Reporting Forms

CODE NO: _____

DATE_____ **TIME**_____

FOUND BY _____ **PHONE** _____

SPECIES: Green ☐ Hawksbill ☐ Loggerhead ☐ Leatherback ☐ Flatback ☐ Unidentified ☐

SEX: Female ☐ Male ☐ Unknown ☐

MATURITY: Immature ☐ Adult ☐ Unknown ☐

LOCATION (place)_____

LOCATION (Lat and Long)_____

CONDITON

ALIVE:		DEAD	
Alert	☐	Carcass in good condition	☐
Weakly responsive	☐	Carcass in fair condition (decomposed, organs intact)	☐
Non responsive	☐	Carcass in poor condition advanced decomposition)	☐
		Mummified carcass	☐
		Disarticulated skeletal remains	☐

INJURIES/CONDITION (mark on drawing) _____

TAGS OR TAG SCARS: _____

Left flipper_____Right flipper_____

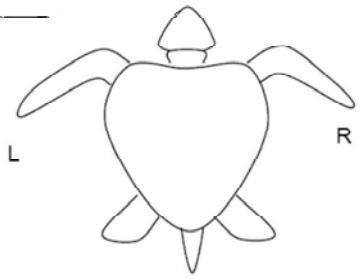
MEASUREMENTS:

Curved carapace length (CCL) _____cm,

Curved carapace width (CCW) _____cm

Tail length _____cm

Head width _____cm



RESULT (swam away, died, location of carcass/skeleton etc)_____

_____

PHOTOGRAPHS: YES location_____ NO

FORM COMPLETED BY_____ PHONE: _____

DNA SAMPLE TAKEN? YES NO

Please use the back of this sheet for any additional notes or details on the stranding →

Department of Biodiversity, Conservation and Attractions

Fauna Report Form

Database No:_____

SPECIES/ANIMAL NAME: **NUMBER SEEN:**

OBSERVATION DATE: TIME: am/pm

OBSERVER NAME/S:

Organisation and Role OR member of public:

EMAIL: PHONE:

OBSERVATION LOCATION: (e.g.property address, street and suburb, distance to nearest intersection, coordinates etc.)

HABITAT INFORMATION: (Was the animal seen in a garden, forest, wetland, farmland etc? Was it sitting in or eating a particular plant?)

CERTAINTY OF ANIMAL IDENTIFICATION:

- Certain ☐
- Moderately certain ☐
- Not sure ☐
- Photo ☐

DESCRIPTION OF ANIMAL: (required to confirm identification OR attach photo) (include information about size, colour, number of animals, age (adult/juvenile) and sex (male/female) of animal etc.)

OBSERVATION: (what was the animal doing? Select any of the boxes below that apply)

METHOD:

- Opportunistic Sighting ☐
- Survey ☐
- Historical (Written) ☐
- Historical (Oral) ☐

TYPE:

- Dawn sighting ☐
- Day sighting ☐
- Dusk sighting ☐
- Night sighting ☐
- Dead (fresh) ☐
- Dead (degenerated) ☐
- Spotlighting ☐
- Remote camera ☐
- Caught/Trapped ☐
- Taken into care ☐
- Released ☐
- Other (specify):

OTHER SIGNS:

- Heard ☐
- Scats ☐
- Tracks ☐
- Diggings ☐
- Nest/Mound ☐
- Natural Hollow ☐
- Artificial Hollow ☐
- Burrow ☐
- Feathers/Hair/Fur/Skin ☐
- Bones ☐
- Eggs/eggshell ☐
- Shell ☐
- Feeding residue ☐
- Fauna run ☐
- Other (specify):

IF DEAD, CAUSE OF DEATH:

- Roadkill ☐
- Found shot ☐
- Found poisoned ☐
- Found drowned ☐
- Stranded on beach ☐
- Annual die off ☐
- Predation by native animal ☐
- Predation by cat/fox/dog ☐
- Starvation/malnutrition ☐
- Unknown ☐
- Other (specify):

OTHER COMMENTS:

Submitter of record: **Organisation and Role:**

Contact Details: **Date Submitted:**

Please return form to: fauna@dbca.wa.gov.au
or Species and Communities Branch, DBCA, Locked Bag 104, Bentley Delivery Centre WA 6983

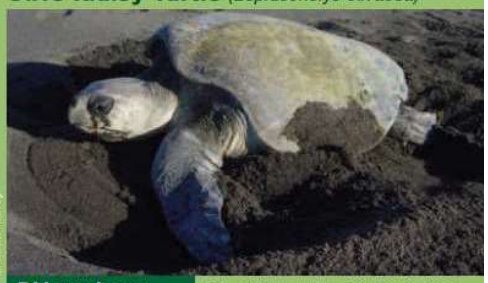
APPENDIX D: Sea Turtle Identification Kit

Great Barrier Reef Marine Turtles

Loggerhead Turtle *(Caretta caretta)*

Did you know . . . Loggerhead turtles get their name because of their large square heads and strong jaws.

Olive Ridley Turtle *(Lepidochelys olivacea)*



© Scott Handy

Did you know . . . Olive Ridley turtles are the smallest of all the marine turtles and their shell is shaped like a heart.

Leatherback Turtle *(Dermochelys coriacea)*

© Scott Handy

Did you know . . . Leatherback turtles are the largest of all the marine turtles with a leather-like shell up to 2.5m in length.

Hawksbill Turtle *(Eretmochelys imbricata)*

Did you know . . . Hawksbill turtles have thick overlapping scales and a distinctive beak. Their shell was once used to make 'tortoiseshell' jewellery.

Flatback Turtle *(Natator depressus)*

Photo: Scott Whiting

Did you know . . . Flatback turtles have a very flat shell with upturned edges. The species is only found on the Australian continental shelf.

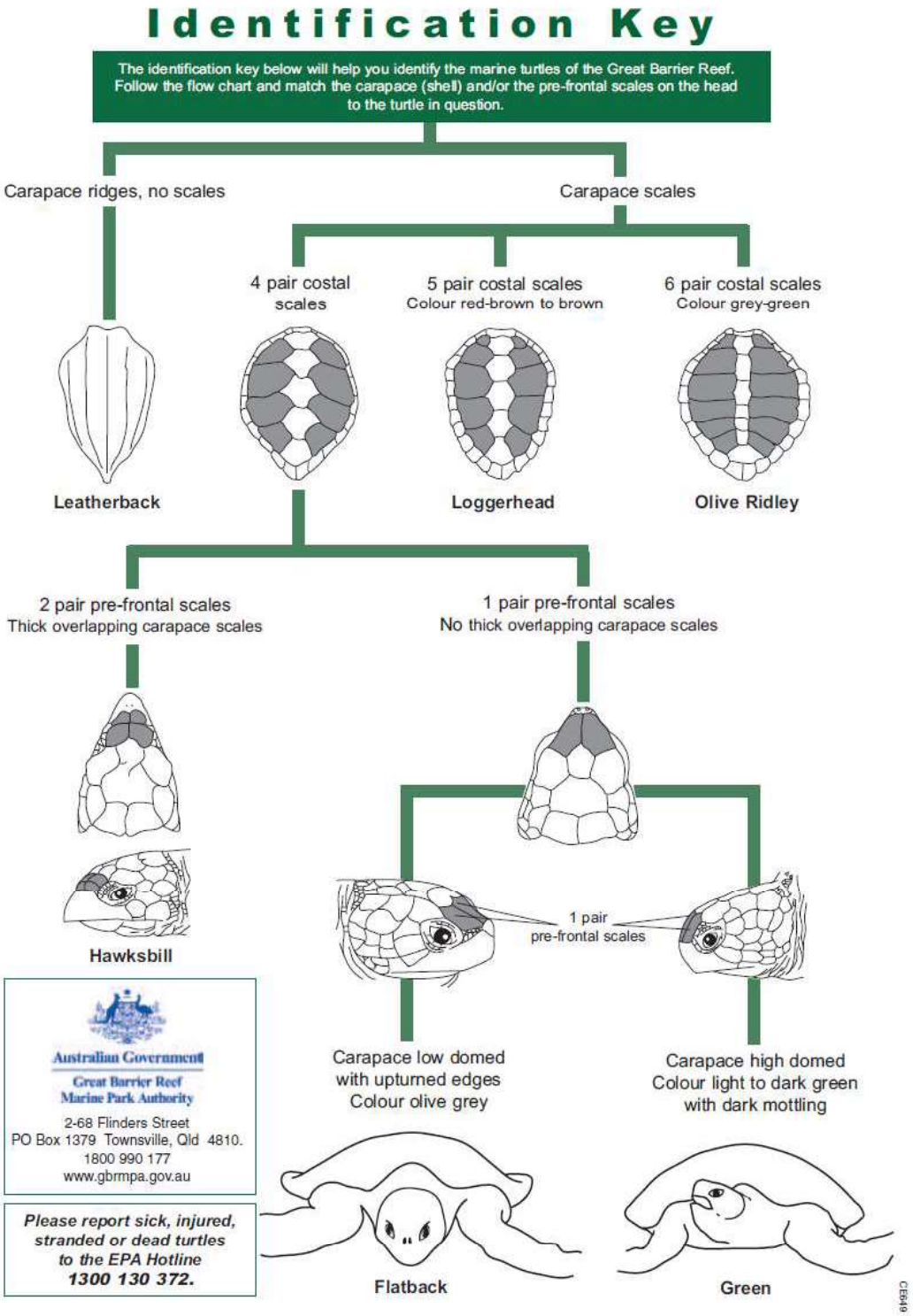
Green Turtle *(Chelonia mydas)*

Did you know . . . Green turtles get their name because their fat is coloured green. They mainly eat algae and other marine plants.

Egg Facts Marine turtles lay between 50 and 200 eggs per clutch. Eggs take about 60 days to hatch.

Australian Government
Great Barrier Reef Marine Park Authority

our great barrier reef
let's keep it great


Identification Key
The identification key below will help you identify the marine turtles of the Great Barrier Reef. Follow the flow chart and match the carapace (shell) and/or the pre-frontal scales on the head to the turtle in question.
Carapace ridges, no scales
Carapace scales
4 pair costal scales
5 pair costal scales
Colour red-brown to brown
6 pair costal scales
Colour grey-green
Leatherback
Loggerhead
Olive Ridley
2 pair pre-frontal scales
Thick overlapping carapace scales
1 pair pre-frontal scales
No thick overlapping carapace scales
Hawksbill
1 pair
pre-frontal scales
Carapace low domed
with upturned edges
Colour olive grey
Carapace high domed
Colour light to dark green
with dark mottling
Australian Government
Great Barrier Reef
Marine Park Authority
2-68 Flinders Street
PO Box 1379 Townsville, Qld 4810.
1800 990 177
www.gbrmpa.gov.au
Please report sick, injured, stranded or dead turtles to the EPA Hotline
1300 130 372.
Flatback
Green
CE649

APPENDIX E: DWER Letter of Approval

Government of Western Australia
Department of Water and Environmental Regulation

Our ref: DWERDT670513
Enquiries: Helen Lafuente, Ph 6364 6482

[redacted]
Burrup Environmental Advisor / Production
Woodside Energy Ltd
Karratha Gas Plant, Pluto Gas Plant and KBSB
Burrup Peninsula
KARRATHA WA 6714

Via email: [redacted]

Dear [redacted]

Ministerial Statement 757 – Pluto LNG – Sea Turtle Management Plan

Thank you for your email of 19 August 2022 submitting the Sea Turtle Management Plan, Revision 11, August 2022, (STMP Revision 11) to the Department of Water and Environmental Regulation (DWER) for review.

I note the plan has been prepared to satisfy conditions 9-1 and 9-4 of Ministerial Statement 757 which state:

9-1 Prior to the commencement of works and in consultation with the Department of Environment and Conservation, the proponent shall prepare a Turtle Management Plan to the requirements of the Minister for the Environment.

The objectives of this Plan are:

- to provide a management framework to enable the proponent to manage the project so as to detect and mitigate as necessary ["mitigate" as defined in Environmental Protection Authority Guidance Statement 9] any impact upon marine turtles from the project; and
- to identify darkness strategies to reduce as far as possible lights or light glow interfering with nesting female turtles and hatchlings.

This Plan shall:

1. identify project-related stressors, causes of environmental impacts and potential consequences for marine turtles (including impact of noise, vibration, light overspill and glow, vessel strike, and changes to coastal processes); and
2. identify and demonstrate the effectiveness of proposed management measures to mitigate [as defined in Environmental

Prime House, 8 Davidson Terrace Joondalup Western Australia 6027
Locked Bag 10 Joondalup DC WA 6919
Telephone: 08 6364 7000 Facsimile: 08 6364 7001
www.dwer.wa.gov.au

Protection Authority Guidance Statement 9] project-related impacts and consequences for marine turtles.

9-4 The proponent shall review the Turtle Management Plan required by condition 9-1 annually to the requirements of the Minister for the Environment.

It is noted that that there are no material changes to performance targets, monitoring measures and management measures in STMP Revision 11 from those in the Sea Turtle Management Plan, Revision 9, April 2020, which was approved by the Minister for Environment on 29 June 2020. Accordingly, the DWER considers STMP Revision 11 to be the current version.

Yours sincerely

Danielle Griffiths
Manager, Strategic Assessments
EPA SERVICES
for the Chief Executive Officer under Notice of Delegation dated 7 October 2022

24 November 2022

APPENDIX F: National Light Pollution Guidelines Management Action Review and Gap Analysis

Table 21 Checklist for new developments or lighting upgrades.

Issue to be considered	Light owner or manager	WEL comments	Regulator	Further information
Pre-development				
What are the regulatory requirements for artificial light for this project?	Is an environmental impact assessment required? What other requirements need to be addressed?	All relevant approvals for the proposed Pluto Expansion were awarded under previous approvals processes described in Section 1.1. Ongoing conditions for managing impacts to marine turtles are contained in WA Ministerial Statement No. 757 and Australian Govt EPBC Referral: (2006/2968).	What information should be sought from the proponent as part of the assessment process?	Regulatory considerations for the management of artificial light
Does the lighting design follow principles of best practice?	What is the purpose of the artificial light for this project?	The Pluto Light Management Plan describes how lighting mitigations will be applied throughout various locations on the facility, dependant on the risk lighting poses to nearby turtle nesting habitat. The mitigation strategy follows best practice.	Does the project use the principles of best practice light design?	Best practice light design

Issue to be considered	Light owner or manager	WEL comments	Regulator	Further information
What wildlife is likely to be affected by artificial light?	Review species information within 20 km of the proposed development.	A detailed impact assessment has already been undertaken for the proposed expansion as part of the Public Environment Report/Public Environmental Review (Woodside 2006) and further summarised for marine turtles in Section 2.	Assess species information.	Wildlife and artificial light
What light management and impact mitigation will be implemented?	What light mitigation and management will be most effective for the affected species?	Biologically relevant light has been considered in the Light Management Plan, with particular relevance for marine turtles. Light sources within the site have been divided into zones based on visibility and potential for impact. A framework for implementation of best practice lighting design has been included in the LMP where required to meet the objectives of the plan.	Is the proposed management and mitigation likely to reduce the effect on listed species?	Species specific technical appendices and species expert guidance
How will light be modelled?	Is light modelling appropriate? How will the model be used to inform light management for wildlife?	No light modelling is planned to address new light sources proposed as part of temporary or expansion operations. Given the presence of other light sources, light modelling would provide limited information to inform light management. Instead, light management will be informed by the process described in the LMP. Periodic light auditing is conducted to verify ambient lighting levels at the nearest sensitive receptor, Holden Beach. A light audit will be conducted	Are the limitation of light modelling for wildlife appropriately acknowledged?	Modelling predicted light

Issue to be considered	Light owner or manager	WEL comments	Regulator	Further information
		upon completion of Pluto Expansion commissioning.		
Have all lighting-relevant considerations been included in the light management plan?	Have all steps in the EIA process been undertaken and documented in the light management plan?	A detailed impact assessment has already been undertaken for the proposed expansion as part of the Public Environment Report/Public Environmental Review (Woodside 2006) and further summarised for marine turtles in Section 2. Proposed temporary and expansion lighting will be within the impacts originally described. The Pluto Light Management Plan describes how lighting mitigations will be applied throughout various locations on the facility, dependent on the risk lighting poses to nearby turtle nesting habitat.	Does the light management plan comprehensively describe all steps in the EIA process?	Environmental impact assessment for effects of artificial light on wildlife Light Management Plan
How will continuous improvement be achieved?	How will light management be evaluated and adapted?	This STMP describes the program of ongoing monitoring of turtle activity at Holden Beach and periodic light auditing at Pluto LNG which includes both temporary and proposed expansion lighting.	Is a continuous review and improvement process described?	Light Management Plan
Post development				

Issue to be considered	Light owner or manager	WEL comments	Regulator	Further information
How will lighting be measured?	What is the appropriate technique for measuring biologically relevant light?	This STMP describes how light measurement techniques will be selected (Section 5.2.1). Light measurement techniques will be selected in respect for the measurement of biologically relevant light, in consultation with relevant expertise.	Ensure appropriate light measurement techniques are used or limitations of methods recognised.	Measuring biologically relevant light
How will lighting be audited?	What is the frequency and framework for in-house light auditing?	This STMP describes the ongoing light auditing program that will be implemented as part of Pluto operations and expansion (Section 5.2.1). This includes monthly light surveys during construction and a 5 yearly lighting audit.	How will the results of light audits feedback into a continuous improvement process?	Artificial light auditing
Is artificial light affecting wildlife?	Does the biological monitoring indicate an effect of artificial light on fauna?	This STMP (Section 4.2) describes how biological monitoring results will be evaluated to identify if artificial light is affecting wildlife including a process for investigation, identification of root causes, rectification and continuous improvement of the STMP.	How will the results of light audits feedback into a continuous improvement process?	Wildlife and artificial light Light Management Plan Managing existing light pollution
What adaptive management can be introduced?	How will the results of light audits and biological monitoring be used in an adaptive management	This STMP is revised annually in accordance with regulatory conditions and considers new information relevant	What regulatory mechanisms can be put in place to ensure that approval conditions can	Light Management Plan

Issue to be considered	Light owner or manager	WEL comments	Regulator	Further information
	framework, and how will technological developments be incorporated into artificial light management?	to the management of impacts from Pluto. Adaptive management is also described in Section 4.2 of this STMP, where biological monitoring feeds back into a continuous improvement process.	adjust to new information? Conditions put in place in 2020 may not be suitable in 2050 for the same project.	

Table 22 Checklist for existing infrastructure

Consideration	Light owner or manager	WEL comments	Regulator	Further information
Are wildlife exhibiting a change in survivorship, behaviour or reproduction that can be attributed to artificial light?	What listed species are found within 20 km of light source? Are there dead animals or are animals displaying behaviour consistent with the effects of artificial light?	The Pluto LNG operational area is within habitat critical and BIAs for marine turtles (Section 2.1.3). The monitoring results to date indicate that there has been limited impacts attributed to artificial light (Section 2.2.3). Some potential disorientation of hatchlings has been observed, however the limited number of disorientation events has made it difficult to determine the source of impact (see Pluto LNG Development Summary Sea Turtle Monitoring Report (2007-2017)). The data gathered over the duration of monitoring indicates that reproductive success of marine turtles on Holden beach remains within the bounds of natural variability (Section 2.2.3).	Is there evidence to implicate artificial light as the cause of the change in wildlife survivorship, behaviour or reproductive output? Review existing environmental approvals.	Describe wildlife Wildlife and artificial light Regulatory considerations for the management of light Species expert advice
Is lighting in the area best practice?	Are there improvements or technological upgrades that could be made to improve artificial light management?	To ensure best practice management of light annual auditing of lighting is undertaken (Section 5.2.1.3). Outcomes of these audits in the past have identified lighting maintenance to be performed that would minimise the potential for lighting impacts on Holden beach. Audit actions which detail these maintenance tasks are tracked by the Pluto Environment Adviser.	Are there individual light owners or managers who can be approached to modify current lighting?	Principles of best practice light management

Is the light affecting wildlife from a single source or multiple sources?	Are there multiple stakeholders that need to come together to address the cumulative light pollution?	There are multiple sources of light visible on Holden Beach. At this point in time there has not been collaboration between the various stakeholders on the Burrup peninsula to consider the cumulative impacts of light.	Is there a role for government to facilitate collaboration between light owners and managers to address light pollution?	Managing existing light pollution Light Management Plan
Can appropriate monitoring be undertaken to confirm the role of artificial light in wildlife survivorship, behavioural or reproductive output changes?	How much light is emitted from my property?	Monitoring appropriate for the size and scale of the marine turtle population is undertaken via an internal annual lighting audit, and an external five yearly audit (Section 5.2).	Facilitate wildlife monitoring.	Field surveys for wildlife Measuring biologically relevant light Species expert advice
How will artificial light be audited?	What is the frequency and framework for in-house light auditing?	See Section 5.2	Can a light audit be undertaken on a regional scale?	Artificial light auditing
What adaptive light management can be introduced?	Are there improvements in lighting technology that can be incorporated into existing lighting?	The data gathered over the duration of monitoring indicates that reproductive success of marine turtles on Holden beach remains within the bounds of natural variability (Section 2.2.3)..Where disorientation is identified, the adaptive management framework (Section 4.2), will be implemented. It is expected that the auditing outlined in Section 5.2 will identify	What changes can be implemented in response to biological monitoring and light audits?	Specialist lighting engineer advice

		if improvements to the lighting technology installed at Pluto LNG are required.		

Pluto LNG – Sea Turtle Management Plan

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