Gorgon Gas Development and Jansz Feed Gas Pipeline

Long-term Marine Turtle Management Plan

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Contents

Tables

Figures

Appendices

1.0 Introduction

Chevron Australia Pty Ltd (CAPL) is the proponent and the person taking the action for the Gorgon Gas Development and Jansz Feed Gas Pipeline on behalf of the following companies (collectively known as the Gorgon Joint Venturers):

- Chevron Australia Pty Ltd
- Chevron (TAPL) Pty Ltd
- Shell Development (Australia) Pty Ltd
- Mobil Australia Resources Company Pty Limited
- Osaka Gas Gorgon Pty Ltd
- Tokyo Gas Gorgon Pty Ltd
- JERA Gorgon Pty Ltd.

1.1 Project

CAPL is developing the gas reserves of the Greater Gorgon Area. The gas will be processed in a Gas Treatment Plant (GTP) on Barrow Island, which is located off the Pilbara coast 85 km north-north-east of Onslow in Western Australia (WA) (Figure 1-1).

Subsea gathering systems and pipelines deliver feed gas from the Gorgon and Jansz–Io gas fields to the west coast of Barrow Island. The underground feed gas pipeline system then traverses Barrow Island to the east coast where the GTP is located. The GTP includes natural gas trains that produce liquefied natural gas (LNG) as well as condensate and domestic gas. Carbon dioxide (CO_2), which occurs naturally in the feed gas, is separated during the production process and injected into deep rock formations below Barrow Island. The LNG and condensate is loaded onto ships from a jetty and then transported to international markets. Gas for domestic use is exported by pipeline from Barrow Island to the domestic gas (DomGas) collection and distribution network on the WA mainland.

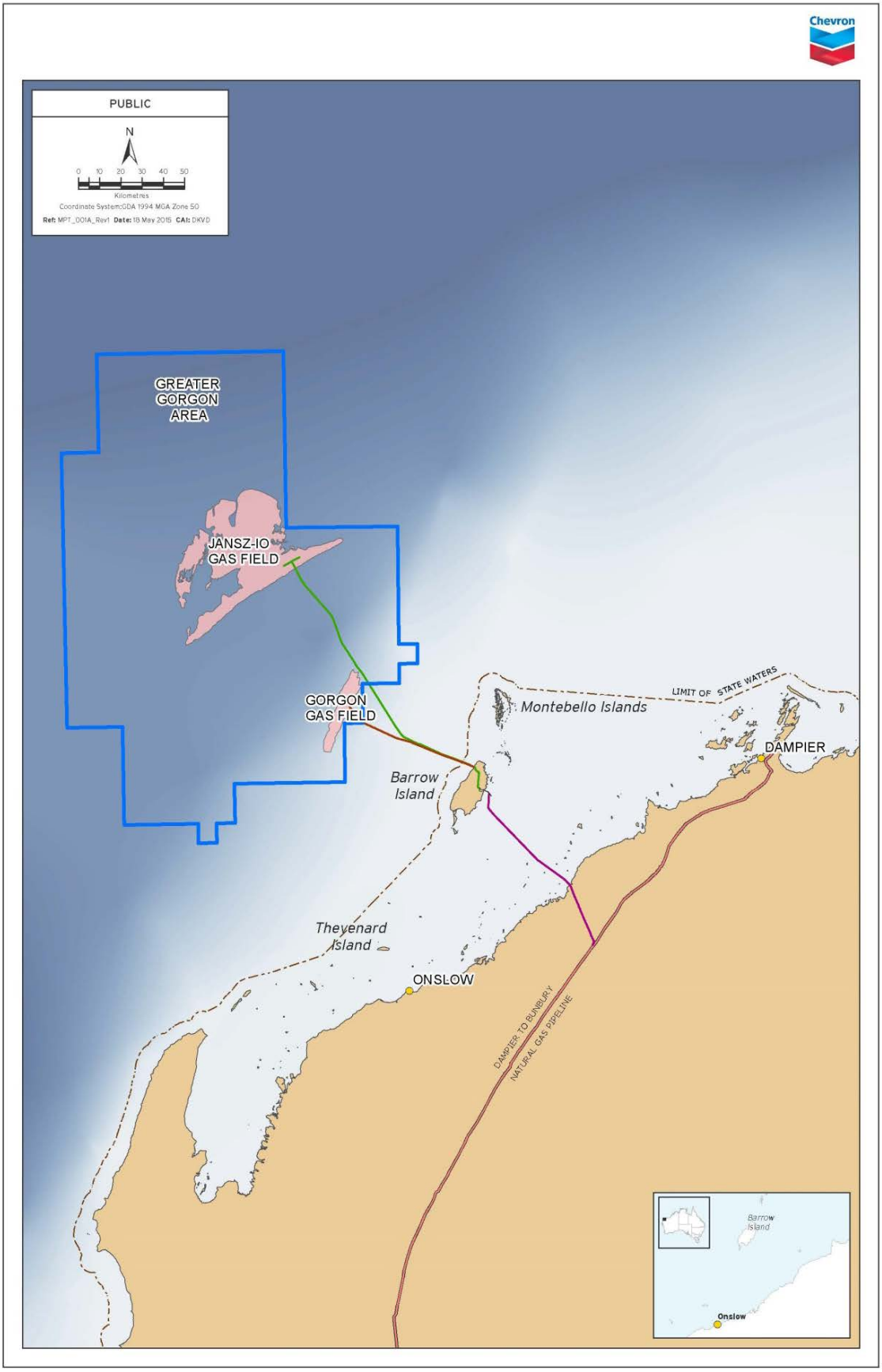

Figure 1-1: Location of Barrow Island and the Greater Gorgon Area

1.2 Environmental Approvals

Table 1-1 describes State (WA) and Commonwealth (Cth) approvals for the components of the Gorgon Gas Development.

These approvals, and projects approved under these approvals, have been and may continue to be amended (or replaced) from time to time.

Table 1-1: State and Commonwealth Approvals

Project Approval Stage	State	Commonwealth
Jansz Feed Gas Pipeline	Ministerial Statement (MS) 769 (Ref. 1) 28 May 2008	EPBC Reference: 2005/2184 (Ref. 2). 22 March 2006
Initial Gorgon Gas Development (2 LNG trains)	Initial Gorgon Gas Development comprising two LNG trains – MS 748 (Ref. 22). This was superseded by MS 800. 6 September 2007	Initial Gorgon Gas Development comprising two LNG trains – EPBC Reference: 2003/1294 (Ref. 5). 3 October 2007
Revised and Expanded Gorgon Gas Development (3 LNG trains)	MS 800 (Ref. 3) provides approval for both the initial Gorgon Gas Development and the Revised and Expanded Gorgon Gas Development (compromising three LNG trains). This statement supersedes MS 748. 10 August 2009	The Revised and Expanded Gorgon Gas Development (EPBC Reference: 2008/4178 [Ref. 4]) was approved, and the conditions for the initial Gorgon Gas Development (EPBC Reference: 2003/1294 [Ref. 5]) were varied. 26 August 2009
Dredging Amendment	MS 865 (Ref. 6) provides approval to establish a restart mechanism in the event of a Project-attributable coral health management trigger. This statement is an amendment to Conditions 18, 20, and 21 of MS 800. 8 June 2011	Not applicable (N/A)
Additional Support Area	MS 965 (Ref. 7) applies the conditions of MS 800 to an Additional Support Area. 2 April 2014	The conditions for the initial Gorgon Gas Development (EPBC Reference: 2003/1294 [Ref. 5]).and for the Revised and Expanded Gorgon Gas Development (EPBC Reference: 2008/4178 [Ref. 4]) were varied. 15 April 2014
Gorgon Gas Development Fourth Train Expansion[1]	MS 1002 (Ref. 17) applies the conditions of MS 800 to the Fourth Train Expansion, and has additional conditions. 30 April 2015	EPBC Reference: 2011/5942 (Ref. 18). 12 May 2016

1.3 Purpose of this Plan

1.3.1 Requirement for this Plan

Note: The requirements text in this Section is based on MS 800. Additional words in the requirements from EPBC Reference: 2003/1294 and EPBC Reference: 2008/4178 are contained in (parentheses), except when they are abbreviations. Any additional words in these requirements from MS 769 are contained in [square brackets].

[1] This Plan will apply to the Fourth Train Expansion once this scope commences.

1.3.1.1 State Environmental Approval Requirement

This Plan is required under Condition 16.1 of MS 800:

> *Prior to commencement of construction of any facility listed in Condition 6.3 or Condition 14.3 to be located on the east coast of Barrow Island, the Proponent shall prepare and submit to the Minister a Long-term Marine Turtle Management Plan (the Plan) that meets the objectives set out in Condition 16.3 and the requirements of Condition 16.4, as determined by the Minister, unless otherwise allowed in Condition 16.1A.*

1.3.1.2 Commonwealth Environmental Approval Requirement

This Plan satisfies the requirements of Condition 12.1 of EPBC Reference: 2003/1294 and 2008/4178:

> *Prior to commencement of construction of any facility listed in Condition 5.2 or Condition 11.3 to be located on the east coast of Barrow Island, the person taking the action must prepare and submit to the Minister, for approval, a Long-term Marine Turtle Management Plan (the Plan) that meets the objectives set out in Condition 12.3 and the requirements of Condition 12.4, as determined by the Minister, unless otherwise allowed in Condition 12.1A.*

1.3.2 Objectives of this Plan

The stated objectives of this Plan in Condition 16.3 of MS 800 and Condition 12.3 of EPBC Reference: 2003/1294 and 2008/4178 are to:

i. *Address the long-term management of the marine turtles that utilise the east coast beaches and waters where there are proposal (action) related stressors to marine turtles;*

ii. *Establish baseline information on the populations of marine turtles that utilise the beaches adjacent to the east coast facilities identified in Conditions 6.3 (5.2) and 14.3 (11.3);*

iii. *Establish a monitoring program to measure and detect changes to the Flatback Turtle population in accordance with Condition 16.4ii (12.4ii); and*

iv. *Specify design features, management measures and operating controls to manage, and where practicable, avoid adverse impacts to marine turtles, with specific reference to reducing light and noise emissions as far as practicable.*

1.3.3 Contents of this Plan

Table 1-2 lists the State and Commonwealth Condition requirements of this Plan and the sections in this Plan that fulfil them.

To satisfy the requirements of Condition 16.4.viii of MS 800 and Condition 12.4.viii of EPBC Reference: 2003/1294 and 2008/4178, CAPL will comply with its obligations under the North West Shelf Flatback Turtle Intervention Program as agreed between CAPL and the WA Minister for the Environment from time to time. This is defined in MS 800 as:

> *If monitoring clearly demonstrates that the Proposal is having a significant impact on the Flatback Turtle population, the Gorgon Joint Venture participants will be required to take or fund further actions to improve recruitment to the turtle population, such as the establishment of hatcheries. Additional funds will be capped at $5 million*.

Table 1-2: Condition Requirements Addressed in this Plan

Note: The requirements text in this table is based on MS 800. Additional words in the requirements from EPBC Reference: 2003/1294 and EPBC Reference: 2008/4178 are contained in (parentheses), except when they are abbreviations. Any additional words in these requirements from MS 769 are contained in [square brackets].

Approval Decision	Condition No.	Condition Requirement	Section in this Plan
MS 800	16.4.i	Report the baseline information on the population of marine turtles that utilise the beaches on the east coast of Barrow Island adjacent to the east coast facilities identified in Conditions 6.3 (5.2) or 14.3 (11.3)	Section 3.0, Appendix A
EPBC Reference: 2003/1294 and 2008/4178	12.4.i		
MS 800	16.4.ii	Define the monitoring program to measure and detect changes to the Flatback Turtle populations. Monitoring methods shall have the ability to detect at a statistical power of 0.8 or greater, or an alternative statistical power as determined by the Minister, on advice of the MTEP, changes or impacts on parameters related to population viability	Section 6.0
EPBC Reference: 2003/1294 and 2008/4178	12.4.ii		
MS 800	16.4.iii	Identify the significant proposal-related stressors with the potential to cause adverse impact on marine turtles	Section 4.2
EPBC Reference: 2003/1294 and 2008/4178	12.4.iii		
MS 800	16.4.iv	Specify design features, management measures and operating controls to manage, and where practicable, aim to avoid adverse impacts to the marine turtles, including, in relation to light emissions, consideration of the following options: • shrouding of lights, including ships and other vessels • relocation or shrouding of flares	Section 5.0
EPBC Reference: 2003/1294 and 2008/4178	12.4.iv		
MS 800	16.4.v	Define the scope of studies aimed at understanding the ecology of marine turtles that utilise the east coast beaches and waters where there are Proposal-related stressors to marine turtles and studies aimed at understanding links between stressors and marine turtle behaviour to improve the management of impacts	Section 7.0
EPBC Reference: 2003/1294 and 2008/4178	12.4.v		
MS 800	16.4.vi	Performance Standards against which achievement of the objectives of this condition can be determined	Section 9.0
EPBC Reference: 2003/1294 and 2008/4178	12.4.vi		
MS 800	16.4.vii	Management Triggers	Section 8.0
EPBC Reference: 2003/1294 and 2008/4178	12.4.vii		
MS 800	16.4.viii	Requirements to comply with the Proponent's (person taking the action) obligations under the North West Shelf Flatback Turtle Intervention Program, such as the establishment of hatcheries as agreed by the Proponent (person taking the action) and the Minister (State Minister) from time to time	Section 1.3.3
EPBC Reference: 2003/1294 and 2008/4178	12.4.viii		

Approval Decision	Condition No.	Condition Requirement	Section in this Plan
EPBC Reference: 2003/1294 and 2008/4178	3.2.1	A description of the EPBC listed species and their habitat likely to be impacted by the components of the action, which are the subject of that plan	Section 3.0, Appendix E
EPBC Reference: 2003/1294 and 2008/4178	3.2.2	An assessment of the risk to these species from the components of the action the subject of that plan, relevant to that plan	Section 4.0, Appendix E
EPBC Reference: 2003/1294 and 2008/4178	3.2.3	Details of the management measures proposed in relation to these species if it is a requirement of the condition requiring that plan	Section 5.0
EPBC Reference: 2003/1294 and 2008/4178	3.2.4	Details of monitoring proposed for that species if it is a requirement of the condition requiring that plan	Section 6.0
EPBC Reference: 2003/1294 and 2008/4178	3.2.5	Performance standards in relation to that species if it is a requirement of the condition requiring that plan	Section 9.0
EPBC Reference: 2003/1294 and 2008/4178	3.2.6	Management triggers in relation to that species if it is a requirement of the condition requiring that plan	Section 8.0
EPBC Reference: 2003/1294 and 2008/4178	3.2.7	Protocols for reporting impacts on the species to the Department	Section 10.0

Any matter specified in this Plan is relevant to the Gorgon Gas Development or Jansz Feed Gas Pipeline only if that matter relates to the specific activities or facilities associated with that particular development.

The sections in this Plan listed in Table 1-2 to meet the conditions of EPBC Reference: 2003/1294 and 2008/4178 shall be read and interpreted as only requiring implementation under EPBC Reference: 2003/1294 and 2008/4178 for managing the impacts of the Gorgon Gas Development on, or protecting, Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) matters. The implementation of matters required only to meet the requirements of MS 800, MS 965, and MS 769 are not the subject of EPBC Reference: 2003/1294 and 2008/4178.

The connection between this Plan and the Coastal Stability Management and Monitoring Plan (CSMMP) (Ref. 8) and CSMMP Management Trigger Supplement (Ref. 9) is described in Section 7.0 (Scope of Studies) andSection 8.0 (Environmental Management Triggers), 9.0 (Performance Objectives and Standards).

1.4 Marine Turtle Expert Panel

In accordance with Condition 15 of MS 800, CAPL has established a Marine Turtle Expert Panel (MTEP) to advise the WA Minister for Environment (the Minister) and CAPL on matters relating to marine turtle monitoring and management for the Gorgon Gas Development, including the development of this Plan.

1.5 Stakeholder Consultation

This Plan and updates of this Plan were prepared in consultation with the:

- WA Department of Water and Environmental Regulation (DWER)
- Commonwealth Department of the Environment and Energy (DotEE)
- WA Department of Biodiversity, Conservation and Attractions (DBCA)
- MTEP.

In relation to the MTEP consultation associated with the development and revision of this Plan, the MTEP provided advice on the content of this Plan and the content of other Environmental Management Plans (EMPs) that require MTEP consultation under State and Commonwealth Ministerial Conditions.

Additional stakeholder consultation and updates to this Plan will be undertaken should analysis of baseline control charts (Appendix A) require amendment to the management triggers defined in Section 8.0. To this end, baseline control chart analysis, and an assessment of the need to amend the management triggers and this Plan, will be completed and submitted to the DotEE and DWER by 1 January 2019 (or another date as agreed by DotEE and DWER).

2.0 Relevant Facilities and Activities

This Plan sets out management of potential environmental impacts to marine turtles associated with construction and operations activities falling under the MS 800, MS 769, and EPBC Reference: 2003/1294 and 2008/417 environmental approvals.

2.1 Terrestrial Facilities

The Gorgon Gas Development Terrestrial Facilities are defined in Condition 6.3 of MS 800 and Condition 5.2 of EPBC Reference: 2003/1294 and 2008/4178 as the:

- Gas Treatment Plant
- Carbon Dioxide Injection system
- Associated Terrestrial Infrastructure forming part of the proposal
- Areas impacted for seismic data acquisition
- Onshore Feed Gas Pipeline System and terrestrial component of the shore crossing.

Terrestrial facilities also include those defined in Schedule 1 of MS 965 (the Additional Support Area). Terrestrial Facilities are shown in Figure 2-1.

2.2 Marine Facilities

The Gorgon Gas Development Marine Facilities are defined in Condition 14.3 of MS 800 and Condition 11.3 of EPBC Reference: 2003/1294 and 2008/4178 as the:

- Materials Offloading Facility (MOF)
- LNG Jetty
- Dredge Spoil Disposal Ground
- Offshore Feed Gas Pipeline System (in State Waters)
- (Offshore) Domestic Gas Pipeline
- Marine upgrade of the existing WAPET Landing.

Marine Facilities of the Gorgon Gas Development are shown in Figure 2-1.

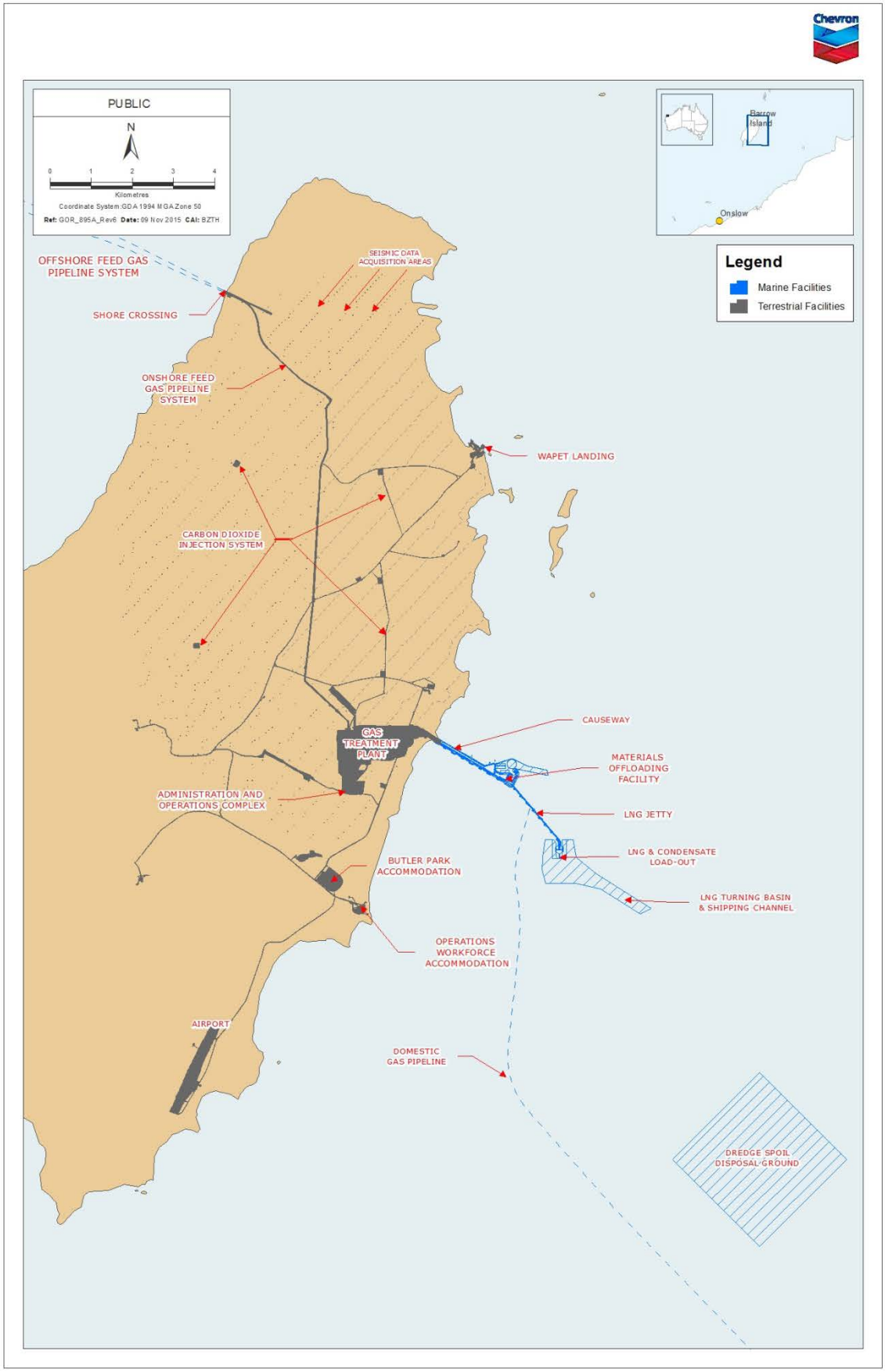

Figure 2-1: Gorgon Gas Development Facilities on Barrow Island

3.0 Baseline Information

Six marine turtle species occur in Australian waters (Loggerhead, Green, Hawksbill, Leatherback, Olive Ridley, and Flatback), all of which have conservation significance and are identified under the EPBC Act as matters of National Environmental Significance (NES). Of the six marine turtle species documented in Australia, only Green, Flatback, and, to a lesser extent, Hawksbill Turtles, nest at Barrow Island (Table 3-1). This Section summarises the baseline information for these species with a focus on the Barrow Island populations. Additional Barrow Island baseline information is also summarised in Appendix A and the Five-year Environmental Performance Report (Ref. 13).

Table 3-1: Conservation-significant Marine Turtle Species Nesting on Barrow Island

Common Name	Scientific Name	Conservation Status				
		EPBC Act (Cth)	IUCN Red List	IOSEA Marine Turtles MOU	Bonn Convention	*Wildlife Conservation Act 1950* (WA)
Flatback	*Natator depressus*	Vulnerable	Data Deficient	Listed	Priority for Conservation	Vulnerable*
Green	*Chelonia mydas*	Vulnerable	Endangered	Listed	Priority for Conservation	Vulnerable*
Hawksbill	*Eretmochelys imbricata*	Vulnerable	Critically Endangered	Listed	Priority for Conservation	Vulnerable*

** Fauna specified Specially Protected under the Wildlife Conservation Act 1950 in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna (January 2017 list).*

3.1 Flatback Turtles

Flatback Turtles are endemic to Australia's continental shelf. Five genetically distinct stocks have been identified: Eastern Australia, Arafura Sea, Joseph Bonaparte Gulf, Southwest Kimberley, and Pilbara Coast (Ref. 64). The North West Shelf Flatback Turtle populations fall within the Pilbara Coast genetic stock, with breeding areas ranging from Exmouth to the Lacepede Islands and across the Pilbara coast; this includes the Barrow Island Flatback Turtle population[2].

3.1.1 Foraging and Mating Behaviour

The locations of mating, post-hatching, and juvenile foraging grounds for Flatback Turtles are not well understood. Juvenile and adult Flatback Turtles are thought to favour soft sediment habitat that supports communities of benthic invertebrates (Ref. 26; Ref. 27). Therefore, the intertidal to nearshore zone at Barrow Island may support foraging assemblages of juvenile and adult Flatback Turtles, where suitable communities of invertebrates are known to occur (Ref. 28). Satellite tracking of adult female Flatback Turtles indicate that they move large distances between multiple geographically distinct areas, ranging from the Pilbara coast to the Gulf of Carpentaria (Ref. 29).

When reproductively active, marine turtles typically migrate to mating grounds offshore from their nesting beach. Mating may also occur along migratory corridors en route to the natal area. After mating, male turtles often return to foraging areas, while females remain at the nesting area (Ref 27; Ref. 30). The location and timing of mating for the Barrow Island Flatback Turtle population is unknown. However, based on records of

[2] Inclusion of a rookery in the North West Shelf Management Unit is based on limited genetic analysis, or known summer breeding activity (Ref. 27; Ref. 64).

Flatback Turtle nesting activity at Barrow Island, mating activity likely occurs between September and January (Ref. 32; Ref. 35).

3.1.2 Nesting Behaviour and Distribution

Flatback Turtle breeding rookeries in Western Australia are located on Barrow Island, Mundabullangana Station, Montebello Island Group, Thevenard Island, Varanus Island, the Dampier Archipelago, and the Kimberley region[3] (Ref. 27). Typically, Flatback Turtle nesting on Barrow Island occurs between October and March, with peak nesting activity occurring between November and January. On Barrow Island, nesting activity is concentrated on the east coast on sandy, low-sloped, low-energy beaches with wide, shallow intertidal zones (Ref. 33; Ref. 35; Figure 3-1). Limited nesting activity has also been recorded on the south-west, north, and north-east beaches of Barrow Island (Ref. 32).

Marine turtles do not reproduce every year. The remigration interval (the frequency at which marine turtles return to the nesting ground to reproduce) of Flatback Turtles at Barrow Island is approximately 1.7 ± 0.8 years (Appendix A). This is shorter than the remigration interval recorded at Mundabullangana (2.2 years) and most other Flatback Turtle rookeries in Australia, which have a mean remigration interval between two and three years (Ref. 34; Ref. 35). This variation in remigration interval between rookeries may reflect variation in other parameters such as the location, quality, and quantity of foraging grounds (Ref. 35). There is evidence that some Flatback Turtles engage in long-distance migrations between foraging grounds and nesting beaches (Ref. 39). Satellite tracking has shown that post-nesting female Flatback Turtles migrate to foraging grounds up to 1800 km from Barrow Island nesting beaches (Ref. 15).

The approximate internesting interval (duration between a successful nest and subsequent nest or nesting attempt) of Flatback Turtles on Barrow Island is seven to 22 days with a mean internesting interval of 14.1 ± 2.3 days, which is similar to other Flatback Turtle rookeries in the Pilbara region (Ref. 13; Ref. 35). The estimated mean clutch frequency for Flatback Turtles at Barrow Island (3.7 clutches per season) is also similar to estimates at other Flatback Turtle rookeries (Appendix A; Ref. 13; Ref. 37).

Satellite tracking at Barrow Island has shown that internesting Flatback Turtles travel distances between 35 km and 242 km, predominantly residing in shallow waters (mean seabed depth of 9.9 ± 4.2 m) off the east coast of Barrow Island and nearshore waters of the WA mainland and surrounding islands (Appendix A; Ref. 13). This pattern of nearshore or long-distance internesting movement is similar to other Flatback Turtle rookeries within the Pilbara region (Ref. 38).

3.1.3 Nester Abundance and Survival

An annual mean of more than 1800 (n=5 years) nesting Flatback Turtles and high annual survival rate of 0.92 was estimated for the Barrow Island rookery from capture–mark–recapture sampling (Ref. 13; Appendix A). The size of the Barrow Island rookery is comparable to Mundabullangana (annual mean of 1861, n=18 years; Ref. 13) and other rookeries in the region (e.g. approximately 3000 Flatback Turtles nesting across the Lowendal and Montebello Islands) (Ref. 33). The Barrow Island rookery is estimated to be smaller than the Cape Domett rookery in far north-west Australia. Cape Domett is one of the largest known nesting aggregations for this species, with track count data suggesting 3250 nesting females per year (Ref. 55).

[3] Note: Limited analysis of DNA material from offshore Kimberley sites and Barrow Island has found that Barrow Island turtles are genetically similar to other Pilbara sites, but are different to the Kimberley sites. This distinction has not yet been confirmed.

3.1.4 Clutch Characteristics

Generally, Flatback Turtle clutches comprise approximately 45–50 eggs (Barrow Island: 48.5 ± 2.6) with an incubation period of approximately 46 days (Barrow Island: 46.8 ± 10.1) (Ref. 35; Appendix A). The prevailing temperature within the clutch during the middle third of incubation determines the hatchling sex ratio. Generally, warmer temperatures produce a higher proportion of female hatchlings and cooler temperatures produce a higher proportion of male hatchlings. Sex ratio and thermal tolerance ranges have been determined for other species of marine turtle. However, these ranges are largely unknown for Flatback Turtles (Ref. 40; Ref. 41). The mean Flatback Turtle clutch temperature was recorded as 32 °C at Barrow Island (Appendix A), which is close to the upper thermal tolerance range estimated for another Flatback rookery (thermal tolerance range 29.3–32.9 °C) and embryos of other marine turtle species (Ref. 41; Ref. 65). Despite the high mean clutch temperatures, incubation success at Barrow Island is high (see Section 3.1.5), indicating that the thermal tolerance range for Flatback Turtle embryos at Barrow Island may be different to other Flatback Turtle rookeries.

3.1.5 Hatching and Emergence Success

Incubation success (determined by measures of egg hatching and hatchling emergence success) depends on many biological and biophysical parameters, including sediment characteristics, predation, disturbance, salinity, inundation and erosion, thermal conditions, and microbial/fungal conditions within the nest (Ref. 30; Ref. 42; Ref. 43; Ref. 44).

Barrow Island reproductive data show that estimated egg hatching success (81%) and hatchling emergence success (75%) fall within the range previously reported for this species in northern Australia (Figure A-2 in Appendix A; Ref. 30; Ref. 40; Ref. 55). Mainland rookeries in the Pilbara region have recorded lower rates of hatching and emergence success, possibly related to the presence of additional predators, higher incubation temperatures, or other variables, such as inundation from storm-surge associated with cyclonic activity (Ref. 35).

3.1.6 Hatchling Orientation and Dispersal

Typically, marine turtle hatchlings emerge from the nest at night, leave their natal beaches, and migrate to nursery habitats (Ref. 45). The period of Flatback Turtle hatchling emergence varies between rookeries and depends on the time of peak nesting and factors influencing incubation. At Barrow Island, Flatback Turtle hatchling emergence usually occurs between January and April, with a peak emergence period between February and March (Ref. 33).

Following emergence from the nest, sea-finding in marine turtle hatchlings is influenced by several cues, including light, beach morphology, and lunar phase. Light is considered the primary cue for sea-finding behaviour—hatchlings use visual cues to crawl away from a tall dark horizon (dunes) towards a lower and lighter seaward horizon (Ref. 46; Ref. 47; Ref. 48; Ref. 49). Monitoring of Flatback Turtle hatchling orientation at Barrow Island demonstrated natural spatial (between and within beaches) and temporal (between season) variation in hatchling spread and offset angles; even with this variation, hatchlings nearly always reached the sea (Ref. 13; Appendix A).

On leaving the beach, hatchlings use wave cues to orient and disperse in an offshore direction (Ref. 48). Little is known about the swimming behaviour of Flatback Turtle hatchlings once they leave their natal beaches. An investigation of hatchling dispersal and survivorship at Barrow Island demonstrated that immediately offshore, Flatback Turtle hatchlings exhibit the same frenzied swimming period as hatchlings from other turtle species, taking them away from shallow water where they are vulnerable to predators. The direction of travel from the east coast beaches was primarily east and north-east, away from the beaches (Ref. 13).

Unlike other marine turtle species, Flatback Turtles do not have a known oceanic development phase; instead, hatchlings are considered to develop in shallow coastal waters without leaving the Australian continental shelf (Ref. 52; Ref. 53). Their precise age at sexual maturity is not known, but is estimated at approximately 20 years (Ref. 27), which coincides with a range of between five and 30 years observed in most marine turtle species (Ref. 52).

3.2 Green Turtles

Green Turtles are widely distributed and are known to breed extensively in north-western Australia (Ref. 56; Ref. 27). The North West Shelf supports one genetic stock of Green Turtles, which nest between the Ningaloo Coast and the Lacepede Islands in the Kimberley region (Ref. 50). This is one of the largest Green Turtle populations in the world and appears to be the largest for the Indian Ocean. The principal rookeries include the Lacepede Islands, Montebello Islands, Barrow Island, North West Cape, and Browse Island (Ref. 27).

Limited long-term census data are available on nesting populations in the Pilbara region. The total Green Turtle population in the region is thought to be about 20 000 individuals (Ref. 54). However, there are suggestions that the Barrow Island nesting population estimate is of this magnitude or larger (Ref. 33), which could double the overall estimate.

Shallow foraging habitat used by adult and juvenile Green Turtles typically comprises seagrass beds or algae mats, and both juvenile and adult Green Turtles have been observed feeding year-round on algae-covered, rocky intertidal and subtidal platforms, off the west and east coasts of Barrow Island (Ref. 54; Ref. 23).

Substantial aggregations of mating Green Turtles can occur in waters and on beaches along the west, north, and north-east coasts of Barrow Island between September and December (Ref. 23).

Green Turtle nesting usually occurs on the west and north-east coasts of Barrow Island between October and March each year, with a remigration interval of approximately five years (Ref. 26) and peak nesting activity occurring between December and February (Ref. 23; Ref. 33; Figure 3-1). The west coast nesting beaches are high-energy, steeply sloped, sandy, and with an unobstructed foreshore approach (Ref. 23), in contrast to the low-energy beaches preferred by nesting Flatback Turtles (Ref. 33).

Green Turtle annual nester abundance at Barrow Island exhibits a cyclical trend linked to El Niño Southern Oscillation cycles (Ref. 31). Between 2008 and 2010, the total number of Green Turtle emergences documented was significantly lower in 2009–2010 (402 emergences) than in 2008–2009 (1921 emergences). Although the numbers of Green Turtles fluctuated each year, the proportion of nesting activity on individual beaches was consistent across the seasons (Ref. 16).

Analysis of satellite tracking data for Barrow Island Green Turtles suggests internesting habitat occurs throughout the rocky intertidal and subtidal platforms common on the west coast, around to the north-eastern beaches and waters (Ref. 23; Ref. 33). These platforms are approximately 10–100 m wide and are often broken up by rock pools and reefs that are also used by post-nesting Green Turtles. Green Turtles that were tracked using satellite transmitters after nesting at Barrow Island migrated to foraging grounds extending from Legendre Island in the Dampier Archipelago to waters in the southern Kimberley (Ref. 33).

The number and size of clutches laid by Green Turtles is larger than those of Flatback Turtles, with an average of five clutches laid per season, each containing approximately 115 eggs. The internesting interval for Green Turtles is around 14 days (Ref. 27; Ref. 54).

The average incubation period for Green Turtle clutches is 64 days, and peak hatchling emergence on Barrow Island usually occurs between February and March (Ref. 54).

3.3 Hawksbill Turtles

Similar to the Green Turtle, Hawksbill Turtles also have a global distribution and are found across northern Australia, including the North West Shelf region of WA, which contains important rookeries for this species in the Indo-Pacific region (Ref. 59; Ref. 57). The WA population is a genetically distinct stock, centred around the Dampier Archipelago (Ref. 58). The estimated size of the reproductive population of WA stock is small, with an overall reproductive population at Barrow Island of 100, an additional 1000 in the Lowendal Islands, and 1300 in the Montebello Islands (Ref. 33).

Surveillance of Barrow Island Hawksbill Turtle nesting has found that nesting activity is more temporally and spatially diffuse than Flatback and Green Turtle nesting activity and occurs predominantly on small, rocky, east coast beaches (Figure 3-1). Nesting on Barrow Island peaks in October (Ref. 13) and Hawksbill Turtles typically have an internesting interval of 14.5 days and a remigration interval of approximately three years (Ref. 23; Ref. 57).

The limited number of Hawksbill Turtles tracked from nesting sites in the Pilbara region show shorter post-nesting migration distances relative to Green and Flatback Turtles in the same region. Satellite tracking of Hawksbill Turtles found that they remained in shallow coastal waters (<10 m deep) (Ref. 33).

Hawksbill Turtle mating, internesting, and foraging grounds have not been identified for Barrow Island. However, data from Hawksbill Turtles tracked from nearby Varanus Island indicate potential internesting habitat in waters north-east of Barrow Island (Ref. 33).

On average, Hawksbill Turtles lay three clutches per season (Ref. 57). Records from WA rookeries estimate 110 eggs per clutch (Ref. 27), which is fewer than other Hawksbill Turtle rookeries where more than 120 eggs have been recorded per clutch.

The incubation period for Hawksbill Turtle clutches is approximately 55 days (Ref. 51), and peak hatchling emergence on Barrow Island usually occurs between November and December (Ref. 33).

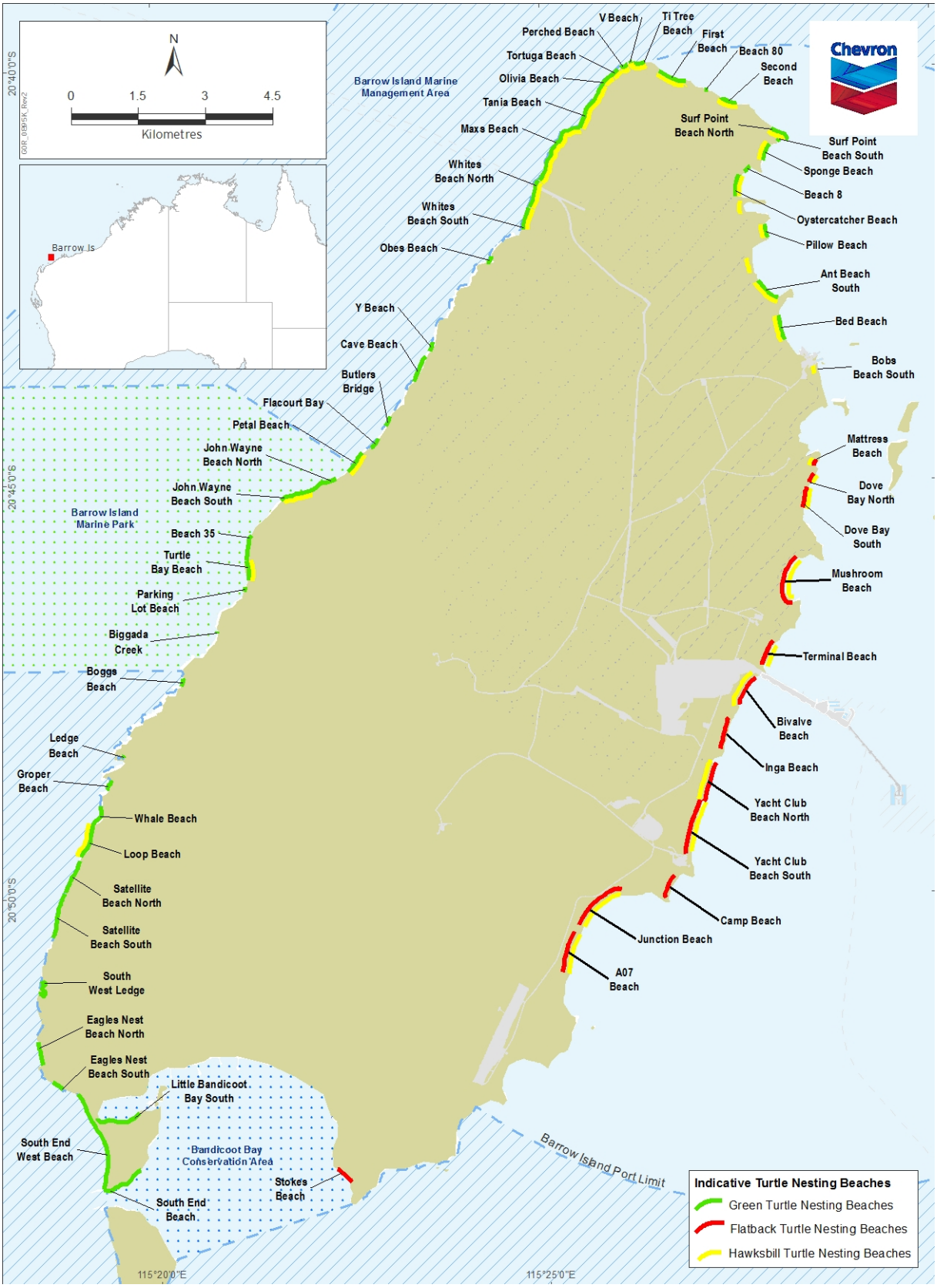

Figure 3-1: Flatback, Green, and Hawksbill Turtle Nesting Beaches on Barrow Island

4.0 Risk Assessment

Risk is the combination of the potential consequences arising from an environmental stressor, together with the likelihood of the stressor occurring and resulting in the consequence. CAPL has developed an internal risk management process using the Chevron Integrated Risk Prioritization Matrix (12.0Appendix C). Table 4-1 summarises the risk assessments undertaken to date using this process that have provided input to this Plan. An assessment of the risk to EPBC Act listed species is outlined in Appendix E.

Table 4-1: Risk Assessments Relevant to this Plan

Scope and Date of Risk Assessment	Documentation
2008: Construction and operation of the Gorgon Gas Development	Long-term Marine Turtle Management Plan (2009) (Ref. 20)
2015[4]: Remaining construction activities and operation of the Gorgon Gas Development	This Plan
2017[4]: Revision to risk profile for potentially significant stressor – Physical presence of infrastructure; Operations; Offshore	This Plan

4.1 Methodology

The main components of the internal CAPL risk assessment methodology include:

- **Specify causes**: Identify possible causes or conditions resulting in a stressor.
- **Determine potential consequences**: Determine the level of harm that could be associated with the stressor.
- **Identify and evaluate safeguards**: Identify design features and operating controls that manage the stressor or otherwise prevent exposures that can result in harm.
- **Apply the Integrated Risk Prioritization Matrix**: Using the Chevron Integrated Risk Prioritization Matrix (12.0Appendix C), assign consequence magnitude and likelihood indices to obtain a risk priority ranking:
  - **Consequence magnitude index**: Maximum credible level of harm that could be associated with the stressor – safeguards *are not* taken into account.
  - **Likelihood index**: Expected frequency of the consequence magnitude occurring – safeguards *are* taken into account.
- **Recommend further study or risk mitigation**: Apply qualitative risk criteria and risk management guiding principles to guide further risk reduction actions, if required.

When determining the level of harm that could be associated with each stressor, these categories of receptors were considered:

- Species:
  - Green Turtle
  - Flatback Turtle
  - Hawksbill Turtle
- Life stage:
  - nesting adults

[4] In consultation with independent marine turtle experts, a specialist marine turtle consultancy, and CAPL. Outcomes of the risk assessment and a subsequent revision to the risk assessment were endorsed by the MTEP in August 2015 and October 2017 respectively.

- breeding / mating adults
- foraging juveniles
- foraging adults
- hatchlings
- eggs.

Table 4-2 lists potentially significant stressors to marine turtles associated with the Gorgon Gas Development that were identified—in consultation with the MTEP—and were subject to evaluation by risk assessment.

Table 4-2: Potentially Significant Stressors to Marine Turtles Associated with the Gorgon Gas Development

Stressor	Sources
Artificial light	**Construction** • Offshore: marine vessel lighting (e.g. construction vessels, barges), lighting associated with constructing the causeway, MOF, and LNG Jetty • Onshore: lighting (including mobile task lighting) • Onshore: flaring (ground and boil-off gas [BOG] Flares) during commissioning
	Operations • Offshore: marine vessel lighting (e.g. tugs, barges, pilot vessels, maintenance vessels), LNG ship and Condensate vessel lighting, lighting associated with operation of the causeway, MOF, and LNG Jetty • Onshore: lighting (including mobile task lighting) • Onshore: flaring (ground flare and BOG flares)
Noise and vibration	**Construction** • Offshore: marine vessel activity • Onshore: earthworks, drilling, vehicles and equipment, explosives • Onshore: commissioning of GTP components (turbines, compressors etc.) • Onshore: vibroseis trucks during seismic survey activities • Onshore: flaring (ground flare and BOG flares) during commissioning
	Operations • Offshore: marine vessel activity and general MOF and LNG Jetty operations, airguns during seismic survey activities, maintenance dredging • Onshore: steady-state operation of the GTP (turbines, compressors, etc.), vehicles and equipment • Onshore: vibroseis trucks during seismic survey activities • Onshore: flaring (ground flare and BOG flares)
Physical interaction	**Construction** • Offshore: marine vessels (e.g. construction vessels, barges, seismic vessels) • Onshore: people, vehicles
	Operations • Offshore: marine vessels (e.g. tugs, barges, seismic vessels, pilot vessels, maintenance vessels), maintenance dredging • Onshore: people, vehicles

Stressor	Sources
Physical presence of infrastructure	**Construction** • Offshore: ocean intakes
	Operations • Offshore: ocean intakes • Offshore: permanent presence of causeway, MOF, and LNG Jetty
Solid and liquid waste discharges to sea	**Construction** • Offshore: wastewater discharge (including reverse osmosis [RO] brine) • Offshore: marine vessel discharges • Onshore: stormwater run-off
	Operations • Offshore: wastewater discharge (including RO brine) • Offshore: marine vessel discharges • Offshore: stormwater run-off • Offshore, onshore: uncontained (e.g. windblown) solid waste
Leaks or spills (loss of containment, unplanned discharges to sea or on turtle nesting beaches)	**Construction** • Offshore: storing, transporting, and handling of hydrocarbons, chemicals, drilling fluids, wastes, and other hazardous materials • Offshore: refuelling • Offshore: marine vessel collision or grounding • Offshore: pipeline failure
	Operations • Offshore: storing, transporting, and handling of hydrocarbons, chemicals, drilling fluids, wastes, and other hazardous materials • Offshore: refuelling • Offshore: marine vessel collision or grounding • Offshore: pipeline failure

After determining the residual risk level using the Chevron Integrated Risk Prioritization Matrix (12.0Appendix C), risk priority rankings (Table 4-3) were assigned to determine if further mitigation and safeguards were required. If it is demonstrated that the cost[5] of implementing further risk reduction measures is disproportionate to the benefit gained, the risk is considered to be as low as reasonably practicable (ALARP).

Table 4-3: Risk Priority Rankings

Residual Risk Level	Risk Priority Ranking	Further Risk Reduction
1, 2, 3, 4	Intolerable	Short-term, interim risk reduction required. Long-term risk reduction plan must be developed and implemented.
5	Tolerable (if ALARP and long-term risk reduction)	Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place **and** additional long-term risk reduction is undertaken.
6	Tolerable (if ALARP)	Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place.
7, 8, 9, 10	Tolerable	Risk tolerable, no further risk reduction necessary

[5] Cost includes financial cost, time or duration, effort, occupational health and safety risks, or environmental impacts associated with implementing the control.

4.2 Outcomes

The 2015 risk assessment assigned updated risk levels, after incorporating the additional information available for:

- drilling and completion during the construction period of the remaining wells associated with the CO_2 injection system
- commissioning activities
- seismic activities (associated with CO_2 injection monitoring both pre- and post-injection)
- operations.

For the other relevant construction activities, the risk levels identified in 2008 were considered to provide a conservative indication of risk levels for the stressors listed in Table 4-2, given that the scale and duration of construction activity remaining by the end of 2015 was considerably less than that assessed previously in 2008. Therefore, these activities were not re-assessed.

The 2015 risk assessment showed a reduced overall risk profile from that identified in the 2008 risk assessment. This change reflects greater certainty regarding Project design features and operations activities, and improved understanding of impacts provided by five years of monitoring the effects of key stressors during construction. Specific factors influencing the changes to identified risks include:

- Relocating the ground flares – After the 2008 risk assessment, the ground flares were moved from within the GTP site to a location north-west of the GTP site, increasing the distance from the nearest turtle nesting beach to more than 2 km.
- Reconfiguring and shielding the ground flares – The design of the relocated flares was altered to comprise four staged flare boxes (reducing the flame height in the flare boxes), and included a 14 m high radiation shield (reducing the potential for light spill).
- The BOG flares are approximately 600 m from the nearest beaches and behind the condensate tanks and are shrouded by radiation shields, reducing the potential for light spill to beaches.
- Monitoring of marine turtle population parameters indicate that stressors during construction have not had an adverse impact on marine turtles at the population level (Ref. 13).
- RO brine discharge modelling confirms rapid dispersion and a localised mixing zone.
- Ocean intake design and flow rates compared to measured ocean currents indicate limited potential to entrain turtles.
- Incident records during marine construction show impacts to turtles from dredging and vessel movements (strike) were fewer than initially expected.
- Monitoring results indicated noise and vibration levels on east coast beaches were not detectable above ambient conditions (Ref. 13).

After investigating the recommendations identified during the 2015 risk assessment and the outcomes of monitoring and studies completed after the 2015 risk assessment, one potentially significant stressor—Physical presence of infrastructure: operations, offshore—was identified for review in 2017.

The 2017 review for this stressor showed an increased risk profile from that identified in the 2015 risk assessment, and alignment with the risk profile identified in the 2008 risk assessment. This change reflects an improved understanding of potential impacts to marine turtle nesting habitat informed by hydrodynamic and sediment transport modelling not available at the time of the 2015 risk assessment (Ref. 24). Specific factors influencing the change to the identified risk include:

- Modelled predictions of further re-alignment of beaches adjacent to the marine facilities are likely to occur over the medium to long-term. Modelling also determined that three nesting beaches were under the hydrodynamic influence of the causeway/MOF (Terminal, Bivalve, and Inga beaches) (Ref. 24).
- Monitoring of beach profiles since the 2015 risk assessment indicated further change to Terminal, Bivalve, and Inga nesting beaches and corresponding reductions in availability (or access to) optimal nesting habitat (Ref. 14; Ref. 25). These observed changes align with modelled predictions.

Table 4-4 and Table 4-5 list the potential impacts with the highest risk rankings assigned to each stressor identified for construction and operations activities respectively. Safeguards (including design features [Sections 5.1 and 5.2] and management measures and operating controls [Section 5.3]) and monitoring results were considered when determining the risk ranking.

Following the 2015 risk assessment and subsequent 2017 revision to the risk profile for the potentially significant stressor, Physical presence of infrastructure: operations, offshore, three stressors to marine turtles (artificial light, physical interaction, and physical presence) were identified in Table 4-4 and Table 4-5 as having a Risk Priority Ranking of *Tolerable (if ALARP)* or *Tolerable (if ALARP and long-term risk reduction)* (i.e. below a Risk Ranking Level of 7). Appendix D provides further justification for determining that these risks have been reduced to ALARP. For all other sources of risk to marine turtles, the 2015 risk assessment found that the risk priority ranking was *Tolerable* (i.e. the residual risk level was 7 or above).

CAPL considers that with appropriate design and by implementing the identified management measures and operating controls (including those described in Section 5.0), the residual risk to marine turtles from construction and operation of the Gorgon Gas Development is tolerable, and further risk reduction is not required. This conclusion was endorsed by the MTEP (December 2015 and again in October 2017).

Table 4-4: Summary of Risk Assessment for Construction Activities at Barrow Island

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
Offshore Construction Period							
Artificial light	Displaced and/or relocated nesting events	Nesting adults (F, h, g)	• Marine vessel lighting design reduces overboard light spill (Section 5.2.2.1) • MOF, LNG Jetty, and causeway lighting design reduces light spill to beaches and sea, and incorporates long-wavelength lighting (Section 5.2.1.1)	1, 2, 3, 4, 6, 7, 11	Tolerable (if ALARP)		Flatback Turtle Abundance and Distribution
	Inhibited night-time mate finding	Breeding / mating adults (F, h)			Tolerable (if ALARP)		
	Dis/misoriented hatchlings at sea Increased predation	Hatchlings (F, h)			Tolerable (if ALARP)		
	Disturbed foraging Increased vessel strikes	Foraging juveniles and adults (F, G, H)			Tolerable	N/A Incident Reporting	
Noise and vibration	Avoidance of noisy areas Decreased nesting events Overall decrease in reproductive output	Nesting adults (F, h)		3, 4 • Marine Facilities Construction Environment Management Plan (MFCEMP Ref. 11) describes management measures for drilling, marine	Tolerable		Flatback Turtle Abundance and Distribution Flatback Turtle Incubation Success

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
				blasting, and impact piling			
	Disrupted mating	Breeding / mating adults (F, h, g)		4 • MFCEMP (Ref. 11) describes management measures for drilling, marine blasting, and impact piling	Tolerable		
	Altered submergence patterns Displaced from foraging grounds Stress-related reactions	Foraging juveniles and adults (F, G, H)			Tolerable		
Physical interaction	Injury or death (vessel strike)	Breeding / mating and foraging adults, juveniles (F, G)		9, 10 • Dredging and Spoil Disposal Management and Monitoring Plan (DSDMMP) (Ref. 60) describes management measures for construction dredging	Tolerable (if ALARP)	N/A Incident Reporting	
Physical presence	Injury or death (entrainment in seawater intakes)	Juveniles and hatchlings (F, g, h)	• Location and design of ocean intakes (Sections 5.1.7.1 and 5.2.1.2)	2, 5	Tolerable	N/A Incident Reporting	

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
Loss of containment	Direct and indirect health effects	All life stages (F, g, h)	• Secondary containment of hazardous materials (Sections 5.2.2.2)	4, 5, 8	Tolerable	N/A Incident Reporting	Flatback Turtle Abundance and Distribution Flatback Turtle Incubation Success
Solid and liquid waste discharges	Effects on habitat Avoidance of areas of decreased water quality	Foraging juveniles and adults (F, G, h)	• Section 5.1.7.1 describes RO brine discharge location and design.	4 • Solid and Liquid Waste Management Plan (SLWMP; Ref. 61) describes management of marine discharges	Tolerable		Flatback Turtle Abundance and Distribution
		Breeding / mating adults (F, h)		4 • SLWMP (Ref. 61) describes management of marine discharges	Tolerable		

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
Onshore Construction Period							
Artificial light	Displaced and/or relocated nesting events	Nesting adults (F, h)	• Facility lighting design reduces light spill to beaches and sea, and incorporates long-wavelength lighting (Section 5.1.1) • Coastal setback(i.e. behind coastal dunes) for GTP (Section 5.1.2) • Additional lighting design features for associated terrestrial infrastructure (Sections 5.1.4.1,)	1, 2, 3, 4, 6	Tolerable (if ALARP)		Flatback Turtle Abundance and Distribution
	Dis/misoriented hatchlings on the beach Reduced survival rates Increased predation from terrestrial predators and lowered fitness (due to entrapment in light spill on beach)	Hatchlings (F, h)			Tolerable (if ALARP)	Flatback Turtle Hatchling Orientation (including measurement of artificial light emissions where reasonably necessary to interpret variation in hatchling dispersal patterns on beaches)	
Noise and vibration	Fewer embryos reaching full-term development	Eggs / embryos (F, h)	• Location and design for onshore CO_2 seismic program (Sections 5.1.6, 5.1.6.1) • Coastal setback for GTP (Section 5.1.2.1)	3, 4, 16	Tolerable		Flatback Turtle Incubation Success
	Dis/misoriented hatchlings on the beach Increased predation levels from terrestrial predators	Hatchlings (F, h)			Tolerable		Flatback Turtle Hatchling Orientation

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
	Deterrent to nesting females	Nesting adults (F)			Tolerable		Flatback Turtle Abundance and Distribution
Liquid waste discharges	Unmanaged stormwater and sediment run-off causing loss of eggs, embryos, and hatchlings	Hatchlings, eggs, embryos (F, h)	• Terrestrial and Subterranean Environment Protection Plan (TSEPP; Ref. 10) describes construction site drainage and stormwater system design	4 • TSEPP (Ref. 10) describes drainage management	Tolerable		Flatback Turtle Incubation Success
Physical interaction	Displaced and/or relocated nesting events Reduced hatching and hatchling emergence success	Nesting adults and hatchlings (F, h)		2, 16, 17	Tolerable	N/A Incident Reporting	Flatback Turtle Abundance and Distribution Flatback Turtle Incubation Success

Note: Capital letter for turtle indicates greater potential impact/risk: F/f: Flatback; G/g: Green; H/h: Hawksbill

Table 4-5: Summary of Risk Assessment for Operations Activities at Barrow Island

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
Offshore Operations							
Physical presence	Changes in turtle nesting/ internesting patterns affect nesting success Changes to incubation environment (beach sediments) Disrupted hatchling dispersal and survivorship in the immediate nearshore zone (after departing the beach) Increased predation risk around the causeway, MOF, and LNG Jetty (may provide artificial habitat that attracts predators)	Nesting adults, eggs / embryos, and hatchlings (F, h)	• Location and orientation of structures reduce effects on wave movements and beach profiles (Section 5.2.1.2) • LNG Jetty design does not impede turtle movement (Section 5.2.1.2)	3, 4 • CSMMP Supplement: Management Triggers (Ref. 9) describes management triggers for changes to available nesting habitat and stability of the beaches	Tolerable (if ALARP and long-term risk reduction)	CSMMP (Ref. 8)	Flatback Turtle Abundance and Distribution Flatback Turtle Hatchling Orientation Flatback Turtle Incubation Success
	Entrainment in seawater intakes causing injury or death	Foraging juveniles and hatchlings (F, g, h)	• Location and design of ocean intakes (Sections 5.1.7.1 and 5.2.1.2)	2, 5 • SLWMP (Ref. 61) describes management of marine discharges	Tolerable	N/A Incident Reporting	
Artificial light	Displaced and/or relocated nesting events	Nesting adults (F, h)	• Marine vessel lighting design reduces overboard	1, 3, 4, 6, 11, 12, 13, 15	Tolerable (if ALARP and long-		Flatback Turtle Abundance and Distribution

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
			light spill (Section 5.2.2.1) • MOF, LNG Jetty, and causeway lighting design reduces light spill to beaches and sea, and incorporates long-wavelength lighting (Section 5.2.1.1)		term risk reduction)		
	Dis/misoriented hatchlings at sea and/or on the beach Increased predation due to entrapment in lit areas	Hatchlings (F, h)				Flatback Turtle Hatchling Orientation (including measurement of artificial light emissions where reasonably necessary to interpret variation in hatchling dispersal patterns on beaches)	
Solid and liquid waste discharges to sea	Avoidance of areas of reduced marine water quality	Breeding/mating adults (F, g, h), foraging adults and juveniles (F, G, h)		4 • SLWMP (Ref.61) describes management for vessel discharges	Tolerable	Marine Environmental Quality Management Plan (MEQMP) (Ref.21)	Flatback Turtle Abundance and Distribution
	Toxicity effects to turtle hatchlings (if present directly under the pump discharge outlet during cleaning)	Hatchlings (F, h)	• SLWMP (Ref. 61) describes design of dosing system	• SLWMP (Ref. 61) describes management for marine discharges	Tolerable	MEQMP (Ref.21) Incident Reporting	N/A Incident Reporting
	Injury or death (entanglement or ingestion of marine debris)	Foraging adults and juveniles (F, G, h)		• SLWMP (Ref. 61) describes waste management	Tolerable	N/A Incident Reporting	
Loss of containment	Direct and indirect health effects on all life stages	All life stages (F, g, h)	• Emergency shutdown (ESD)	4, 5, 8	Tolerable	N/A Incident Reporting	Flatback Turtle Abundance and Distribution

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
			systems (Section 5.2.1.3) • Emergency release couplings (Section 5.2.1.3) • Secondary containment of hazardous materials (Sections 5.2.2.2)				Flatback Turtle Incubation Success
Physical interaction	Injury or death (vessel strike, entrainment in dredge, entanglement in seismic array)	Foraging juveniles and adults, breeding / mating adults (F, G, h)	• Turtle deterrent devices on dredge (Section 5.2.3.1) • Turtle guard on seismic array (Section 5.2.4.1)	9, 10, 12, 14, 15	Tolerable	N/A Incident Reporting	
Noise and vibration	Displaced and/or disturbed foraging behaviour Stress-related reactions	Foraging juveniles and adults (F, g, h)	• Low-energy seismic acoustic source (Section 5.2.4.1)	3, 4, 12	Tolerable		
	Avoidance of noisy areas Decreased nesting events Overall decrease in reproductive output	Nesting adults (F, h)					Flatback Turtle Abundance and Distribution Flatback Turtle Incubation Success
	Dis/misoriented hatchlings at sea	Hatchlings (F, h)					

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
Onshore Operations							
Artificial light	Displaced and/or relocated nesting events	Nesting adults (G, F, h)	• Facility lighting design reduces light spill to beaches and sea, and incorporates long-wavelength lighting (Section 5.1.1) • Coastal setback for GTP (Section 5.1.2.1) • Lighting regimes relevant to beach proximity for GTP areas (Section 5.1.2.1) • GTP design for no routine flaring (Section 5.1.3.1) • Flare location, configuration, and shrouding reduces light spill (Sections 5.1.3, 5.1.3.1) • Additional lighting design features for associated terrestrial infrastructure (Sections 5.1.4.1, 5.1.5.1)	1, 2, 3, 4, 6, 18, 19 • Air Quality Management Plan (AQMP; Ref. 12) describes management of flaring	Tolerable		Flatback Turtle Abundance and Distribution
	Dis/misoriented hatchlings on beaches Increased predation from terrestrial predators and lowered fitness (due to entrapment in light spill on beach)	Hatchlings (F, h)		1, 2, 3, 4, 6, 18, 19 • AQMP (Ref. 12) describes management of flaring	Tolerable (if ALARP)	Flatback Turtle Hatchling Orientation (including measurement of artificial light emissions where reasonably necessary to interpret variation in hatchling dispersal patterns on beaches)	

Stressor	Potential Impact	Receptor (Species)	Safeguard		Risk Priority Ranking	Monitoring Program	
			Design Features	Management Measures (Table 5-3)		Stressor	Ecological
Noise and vibration	Fewer embryos reaching full-term development	Eggs / embryos (F, h)	• Location and design for onshore CO_2 seismic program (Section 5.1.6.1) • Coastal setback for GTP (Section 5.1.2.1) • Soundproof housing and/or acoustic insulation on noisy equipment (Section 5.1.2.2) • GTP design for no routine flaring (Section 5.1.3.1) • Flare location and configuration (Section 5.1.3.1)	3, 4, 16	Tolerable		Flatback Turtle Incubation Success
	Dis/misoriented hatchlings and increased predation levels on beaches	Hatchlings (F)			Tolerable		Flatback Turtle Hatchling Orientation
	Deterrent to nesting females	Nesting adults (f, g, h)			Tolerable		Flatback Turtle Abundance and Distribution
Solid and liquid waste discharges to sea	Injury or death (entanglement or ingestion of marine debris)	Foraging adults and juveniles (F, G, h)		• SLWMP (Ref. 61) describes waste management	Tolerable	N/A Incident Reporting	
Physical interaction	Displaced and/or relocated nesting events Reduced hatching and hatchling emergence success	Nesting adults and hatchlings (F, h)		2, 15, 16, 17 • SLWMP (Ref. 61) describes waste management	Tolerable	N/A Incident Reporting	Flatback Turtle Abundance and Distribution Flatback Turtle Incubation Success

Note: Capital letter for turtle indicates greater potential impact/risk: F/f: Flatback; G/g: Green; H/h: Hawksbill

5.0 Design Features, Management Measures, and Operating Controls

This Section describes the design features, management measures, and operating controls relevant to this Plan that CAPL—in consultation with relevant stakeholders—has developed to manage, and where practicable aim to avoid, adverse impacts to marine turtles from the Gorgon Gas Development. Management measures listed in Table 5-3 correspond to stressors identified in Table 4-4 and Table 4-5 and include those that apply to the relevant matters of NES identified in Table 3-1.

5.1 Design Features of Terrestrial Facilities

5.1.1 Common Lighting Design Principles

Overall lighting management seeks to minimise light that may have an adverse impact on marine turtles, subject to operational and safety requirements. This Section describes the lighting design principles common to most terrestrial facilities. Lighting management for the Gorgon Gas Development is based on the following hierarchy of controls, starting with the most efficient through to the least efficient:

- **Elimination**: Eliminating the light by removing, or completely shielding, the light source.
- **Substitution**: Replacing the light source with another source that has fewer environmentally hazardous properties (e.g. change in spectral properties of lighting).
- **Reduction**: Reducing light emissions (e.g. reducing the amount of light escaping from a light source by shielding, shrouding, or screening or orientating away from the beach).
- **Administrative Controls**: Operating procedures to restrict light exposure (e.g. blinds down on windows and turning task lighting off when not in use).

These lighting design principles were incorporated in terrestrial facility outdoor lighting, where practicable:

- Light location and direction:
  - Mount lights as low as practicable.
  - Use shielded light fittings and directional lights.
  - Use downward-facing lights.
  - Orientate lights away from the coast.
- Acceptable lighting types (subject to operational and safety requirements):
  - Use light types that are least disruptive to marine turtles, including long-wavelength (>560 nm with a Colour Rendition Index [CRI] >20 Ra reduced spectrum – i.e. yellow/orange) and low-wattage lights.
- Light reduction techniques:
  - Switch task lighting on only when required to undertake a task.
  - Minimise the number of windows facing the coastline or beach areas and install window treatments (e.g. tinting, curtains, opaque blinds).
  - No decorative lighting.
  - No unnecessarily bright lights.

5.1.2 Gas Treatment Plant

The GTP is oriented east–west, with most of the facility located behind the foredunes and at least 200 m from the nearest beaches.

5.1.2.1 Lighting

The permanent lighting design of the GTP comprises three external lighting regimes:

- **Normal Lighting**: This is the normal ingress and egress lighting system along walkways and general areas. Under normal operating conditions, only the luminaires designated as 'Normal' and 'Normal/Emergency' are designed to be 'on' as they are photocell-controlled. Some of the normal lighting luminaires are designed as emergency lighting and, on loss of main power, illuminate escape routes. Pedestrian lighting uses LED, high-pressure sodium with dichroic filter, or yellow fluorescent luminaires.
- **Area Task Lighting**: This is organised into discrete work areas; it is normally 'off' and only switched 'on' to provide the necessary task lighting when required. Manual switching is used so the operator can control lighting on entering/leaving the work area, with remote indication in the Administration and Operations Complex (to monitor/oversee usage). Area task lighting levels vary according to the area and the equipment in that area, and enable safe access, egress, and working conditions for personnel.
- **Emergency Lighting**: Emergency escape lighting is incorporated into normal lighting, thus reducing the total number of installed luminaires.

A zonation approach was applied to the GTP, with emphasis on reduced lighting in areas closest to beaches. Table 5-1 outlines the differences between the three external lighting regimes of the GTP outlined above.

Table 5-1: Relevant External Lighting Design Features Associated with Proximity of GTP Areas to the Beach

Proximity to Beach	Relevant Design Features
GTP facilities within 500 m of beach	This area is designed to be normally dark at night, with normal, normal/emergency, and task lighting manually switched on by an operator entering the area. Exemptions: • Normal and normal/emergency lighting is switched on automatically at night via photocell control at the Wastewater Treatment Plant and utility and process area where there is a safety requirement, such as areas containing rotating equipment. • Shielded lighting is installed at entrances and along defined footpaths to Quarantine Approved Premise (QAP) buildings. • Escape routes (roadways) are marked by road studs (solar-powered and/or reflective) and escape signs. Additional exemptions to lighting requirements may be permitted for operational or safety requirements if a risk assessment is undertaken to ensure potential risks to marine turtles are reduced to ALARP.
GTP facilities more than 500 m from beach	• Where practicable, lighting in elevated locations (such as stand-alone tanks) is normally off and manually switched, with switches at the bottom of tanks for stair access and switches at the top for tank-top lighting. • Car parking areas at the GTP are not lit, except if required for safety. Pedestrian areas around car parks are locally lit with low-level lighting.

5.1.2.2 Noise and Vibration

Features incorporated in the design of GTP infrastructure to reduce noise and vibration emissions include, where practicable:

- air inlet silencers and acoustic enclosures on gas turbines, and silencers for exhaust stacks
- acoustic blankets and/or motor enclosures on pumps, where required
- exhaust gas silencer on the diesel engine for firewater pumps
- thermal insulation on Heating Medium Heaters, which also helps reduce noise
- exhaust gas silencer for the bypass stacks of the Waste Heat Recovery Units
- acoustic enclosure and exhaust gas silencer for the diesel engine in the Emergency Diesel Generator Package
- acoustic insulation on the compressor suction/discharge/recycle piping, LNG/Mixed Refrigerant expander suction/discharge piping, large pump suction/discharge/recycle piping, and high-pressure drop valves and piping
- vibration isolation between piping and pipe supports
- acoustic insulation on supporting structures for piping.

5.1.3 Flares

The GTP is designed for no routine flaring during normal operations, aside from flare pilots and purge gas to ensure the availability of this critical safety system at all times.

At their closest, the ground flares are more than 2 km from the nearest turtle beach.

The BOG flares are within the GTP site, approximately 600 m from the nearest beaches and located behind (i.e. west of) the condensate tanks and General Utilities Area.

5.1.3.1 Artificial Light

Both the ground and BOG flares have light- and radiation-shielding walls, and use a non-elevated design, which reduces the potential for lighting (and noise) impacts to turtle beaches.

To minimise flaring and artificial light emissions, the flare systems are designed to flare pilot and purge gas only during routine operations, with no routine flaring beyond that required for safe operation of the flare system.

Ground Flares

The four ground flare boxes are surrounded by louvred light spill and heat radiation shields, extending to at least 14 m above ground level.

The ground flare comprises four flare box stages, each containing multiple burner racks that are close to the ground (approximately 3 m above ground level) to reduce light spill. Gas flow to the flare is staged between multiple burners and flare boxes, thus reducing flame height and light spill.

Flaring via the ground flares is reduced through these design features:

- specified minimal/low purge gas requirements
- low-pressure hydrocarbon process streams redirected to the fuel gas system or to the process where practicable
- where practicable, compressors and other systems designed to start-up, operate continuously, and shut down on full recycle.

BOG Flares

There are two circular BOG flares, surrounded by louvred light spill and heat radiation shields that extend approximately 25 m above ground level.

The BOG flare burner racks are close to the ground (approximately 4 m above ground level), with multiple burner racks to reduce flame height and light spill.

Flaring via the BOG flares is reduced through these design features:

- a BOG compressor, to compress BOG from the LNG tanks for re-use as fuel gas within the GTP

  a BOG recycle compressor, to compress BOG from LNG ships during LNG loading operations for re-use as fuel gas within the GTP. The BOG recycle compressor provides redundancy for the BOG compressor when not engaged in loading operations. This reduces the potential for flaring if the BOG compressor fails.

5.1.4 Associated Terrestrial Infrastructure

The associated terrestrial infrastructure with greatest potential for impacts to turtles, primarily through light emissions, are:

- Butler Park (formerly known as the Construction Village)
- Administration and Operations Complex
- Operations Workforce Accommodation
- WAPET Landing.

5.1.4.1 Artificial Light

In addition to the general lighting design principles outlined in Section 5.1.1, specific features at these facilities to reduce lighting effects to turtle beaches are listed below.

Butler Park

- The layout of Butler Park uses the accommodation buildings to shield the main recreational areas from beaches.
- Pedestrian lighting within Butler Park uses LED, high-pressure sodium with dichroic filter, or yellow fluorescent luminaires.
- All sports lighting luminaires are shielded and are on automated timers.
- Elevated outdoor sports/swimming pool lighting has downward light output with additional shielding.

Administration and Operations Complex

- 24-hour work areas are mainly indoors in offices, warehouses, and workshops.
- The layout of the Complex is designed to shield outside work areas from beaches.

WAPET Landing

- Pedestrian walkway lighting uses low-wattage, long-wavelength lights.
- Lights that must be permanently on (over distribution boards and valves) are low-wattage, long-wavelength, directed downwards, and face away from the ocean.

5.1.5 Carbon Dioxide Injection System

The CO_2 injection wells are set back more than 1.6 km from the nearest east coast turtle nesting beaches.

5.1.5.1 Artificial Light

Lighting at the injection wells follows the design principles outlined in Section 5.1.1, with task lighting manually switched on if required.

The CO_2 injection wells are not staffed, and are designed to be operated remotely from the Administration and Operations Complex. Consequently, minimal external lighting is used under normal conditions.

5.1.6 Onshore Seismic Data Acquisition

The areas impacted for seismic data acquisition (e.g. onshore seismic lines) do not traverse any beaches. The closest downhole charge detonation ('shothole') locations are more than 100 m from the coast.

5.1.6.1 Noise and Vibration

The design of the onshore seismic program is based on using an energy source (surface vibroseis) that generates limited lateral vibration transmission and, if required, downhole (shothole) charge detonations. The charges are relatively small and detonated at depth within the shothole (near the watertable where practicable), minimising potential noise emissions.

5.1.7 Reverse Osmosis Facilities

Temporary and permanent RO facilities are located within the utilities areas of the GTP site.

5.1.7.1 Physical Presence

The temporary RO facility seawater intake pipes extend approximately 700 m offshore and are secured to the sea floor with concrete clump weights. The intakes are screened, limiting the intake velocity at the screen to a maximum of 0.1 m/s. The outfall pipe (with end diffusers designed to achieve a minimum of 40 dilutions in the near-field) is anchored to the sea floor approximately 900 m from the shore.

The permanent RO facility is supplied with sea water from a caisson installed within the MOF structure approximately 1.3 km from shore. The inlet holes on the caisson are covered by approximately 10 m of rock armouring, separating the inlet holes from the open water and limiting the intake velocity to a maximum of 0.1 m/s. The outfall pipe (with end diffusers designed to achieve a minimum of 40 dilutions in the near-field) is located within two caissons on the MOF approximately 2 km from the shore.

5.2 Design Features of Marine Facilities

5.2.1 MOF/LNG Jetty

5.2.1.1 Artificial Light

The MOF and LNG Jetty have normal, normal/emergency, and task lighting that meets these specifications, where practicable:

- Lighting has a colour spectrum predominantly in the yellow/orange region, mainly in the colour spectrum greater than 560 nm wave length with a CRI >20 Ra.
- Navigation lighting is installed in accordance with marine safety standards.
- Emergency lighting luminaires are part of the normal lighting system, and will illuminate if main power is lost.
- Escape routes along roadways are marked by road studs (solar-powered and/or reflective) and signs.

- Task lighting levels comply with marine facilities' legislation and standards, and:
  - lights are mounted low, shielded where required, and focused on the task area to avoid spill onto the surrounding waters
  - for elevated light, are limited to poles less than 4 m high.

Table 5-2 outlines specific design features relevant to the MOF/LNG Jetty area.

Table 5-2: Relevant Lighting Design Features Associated with Proximity of MOF/LNG Jetty Areas to the Beach

MOF/LNG Jetty Area	Relevant Design Features
MOF Causeway	• No permanently 'on' lights are installed between the beginning of the MOF causeway and the MOF, except for the MOF access road, which is an emergency escape route and has LED solar-powered and reflective studs (cats eyes). • Several valve access platforms have manually switched (normally off) fluorescent lighting.
MOF	• Normal, normal/emergency, and task lighting is manually switched when required to undertake a task. Upon power failure, emergency lighting will illuminate. • LED solar-powered and/or reflective road studs (cats eyes) will delineate escape routes between points of emergency lighting.
LNG Jetty	• No permanently 'on' lights are installed along the LNG Jetty, except for the jetty roadway, which is an emergency escape route and has LED and/or reflective solar-powered studs (cats eyes). • The seawater firewater pumps have manually switched normal, normal/emergency, and task lighting. • Several other places along the LNG Jetty have normal/emergency lighting, which is manually switched.
LNG Jetty head	• No permanently 'on' lights are installed on the LNG Jetty head except for the roadway, which is an emergency escape route and has LED and/or reflective solar-powered studs (cats eyes). • The task, normal, and normal/emergency lighting at the LNG Jetty head are manually switched, including the normal/emergency lighting for the primary and secondary escape routes. • All photocell-controlled lights on the LNG Jetty head have manual switches so they can be turned off when not required for loading/unloading operations, berthing/mooring, and maintenance activities.

5.2.1.2 Physical Presence

The intakes for the firewater system are located approximately mid-way along the LNG Jetty. The firewater pumps are only operated during testing and in an emergency. The intakes are screened, with a flow rate across the screens comparable to measured ambient current speeds in the MOF area.

5.2.1.3 Loss of Containment

The potential for impacts from loss of containment during bulk transfer operations of hydrocarbons or chemicals over water is minimised through design features, including those listed below.

Gorgon Marine Terminal Loading platform (LNG)

- Ship-to-shore linked ESD
- Redundancy in ship-to-shore link for LNG
- Manual ESD of LNG loading system by ship or shore operator

- Powered emergency release coupling on LNG loading arms if the vessel moves away from the loading arm envelope.

Gorgon Marine Terminal Loading platform (Condensate)

- Condensate loading protected by an ESD system
- Manual ESD of condensate system by ship
- Powered emergency release coupling on condensate loading arms if the vessel moves away from the loading arm envelope.

MOF Heavy Lift Facility Berth

- Diesel loading facility has dry-break couplings in the line from ship to shore
- Monoethylene glycol (MEG) loading system has dry-break couplings in the line from ship to shore.

5.2.2 Vessels

Vessels with a permanent presence within the Port of Barrow Island have adopted the design features listed in the subsections below, where practicable.

5.2.2.1 Artificial Light

Light Location and Direction

- Lights are directed onto work areas (i.e. use spotlights instead of floodlights) to minimise light spill into the water.
- Deck lights are installed as low as practicable and directed away from the edge of the deck, for safe personnel and vessel operations.
- Light fittings are:
  - shielded/or recessed
  - directional and downward-facing if elevated.
- Blinds are installed on portholes to manage light spill from cabins and internal work areas.

Acceptable Lighting Types (subject to operational safety requirements)

- Light types that are least disruptive to marine turtles are used, including long-wavelength (reduced spectrum) and low-wattage lights (e.g. yellow/orange lights rather than white lights), or with yellow/orange filters installed on white lights.

Light Reduction Techniques

- Where practicable, lighting is manually switched ‘on’ and manually switched ‘off’ when not required.

5.2.2.2 Loss of Containment

Diesel supply vessels have multiple discrete tanks (isolating inventories) and are double-hulled. Deck bunding is in place to capture any on-board spills.

5.2.3 Maintenance Dredging

5.2.3.1 Physical Interaction

Any requirements for maintenance dredging are yet to be confirmed but it is expected that such dredging would be an infrequent activity undertaken by specialist contractors supplying their own vessels and equipment. Therefore, the design features of the vessel(s) and/or equipment involved will be influenced by the specific scopes of work and contractor/vessel availability.

If maintenance dredging is required during turtle season, using turtle deterrent devices on Trailing Suction Hopper Dredges would be considered.

5.2.4 Offshore Seismic Data Acquisition

5.2.4.1 Noise and Vibration / Physical Interaction

Any requirements for offshore seismic (for injected CO_2 monitoring) work are yet to be confirmed but it is expected that such seismic work would be an infrequent activity undertaken by specialist contractors supplying their own vessels and equipment. Therefore, the design features of the vessel(s) and/or equipment involved will be influenced by the specific scopes of work and contractor/vessel availability. If offshore seismic work is required during turtle season, these design features would be considered:

- using a low-energy acoustic source for the marine seismic program
- using 'turtle friendly' tail buoys or turtle guards on the seismic array, where practicable.

5.3 Management Measures and Operating Controls

The specific management measures and operating controls listed in Table 5-3 were identified to manage, and where practicable, avoid adverse impacts to marine turtles. Table 5-4 summarises those management measures relevant to marine turtles that are being implemented to address other legislative requirements. These management measures are not included in Table 5-3, as compliance with these requirements is managed outside this Plan.

The management measures listed in Table 5-3 do not preclude implementation of additional management measures or preventive mitigation action to manage, and where practicable, avoid adverse impacts to marine turtles from potentially significant stressors identified in Section 4.0. Any proposed preventive mitigation action will be developed in consultation with the MTEP, and a proposal will be submitted to DWER and DotEE for approval.

Table 5-3: Risk Management Measures/Operating Controls

Ref No.	Management Measure/Operating Control	Phase
1.	Lighting inspections of worksites and vessels with a permanent presence in the Port of Barrow Island will be undertaken during the turtle season.	All phases
2.	Site-based personnel working on the Gorgon Gas Development will be made aware of marine turtle management at Barrow Island.	All phases
3.	Monitoring programs will be implemented as outlined in Section 6.0.	All phases
4.	Studies will be implemented as outlined in Section 7.0	All phases
5.	Appropriate emergency response will be implemented in the event of a loss of containment.	All phases
6.	Installation of new permanent lighting, or the maintenance or alteration of existing permanent lighting at onshore, MOF, and LNG Jetty facilities will be consistent with the common lighting design principles described in Section 5.1.1.	All phases
Offshore		
7.	Risk-based inspections of vessels will be undertaken before mobilisation to identify potential strategies to reduce artificial light spill from vessels.	Construction
8.	Procedures will be implemented to prevent loss of containment during the bulk transfer of hydrocarbons and chemicals to/from vessels.	All phases

Ref No.	Management Measure / Operating Control	Phase
9.	Vessel movements, including any imposed speed restrictions within the Port of Barrow Island, will be under the control of the Barrow Island Port Captain.	All phases
10.	If marine turtles are sighted near the path of a vessel, vessels will divert to avoid them (if safe to do so), or slow down to idling speed.	All phases
11.	Vessels (other than LNG ships and condensate vessels) working at night within the Port of Barrow Island during turtle season will be required to reduce lighting to the minimum required for safe operations.	All phases
12.	Management of offshore seismic data acquisition will include: • maintaining marine fauna observers (MFOs) on seismic vessels during turtle season • using soft-start procedures to warn marine fauna (including marine turtles) before startof marine data recordings • where practicable, scheduling seismic activities outside turtle season • if seismic activities occur during turtle season, reducing lighting to the minimum required for safe operations.	All phases
13.	The Barrow Island Terminal Regulations require all LNG ships and condensate vessels entering the Port of Barrow Island to make best endeavours to reduce light spill and direct overboard lighting to the absolute minimum levels required, while meeting their own and regulatory safety and security requirements.	All phases
14.	If maintenance dredging occurs during turtle season, MFOs will be maintained on dredge vessels.	Operations
15.	If major repairs of the DomGas pipeline are required in the waters surrounding Barrow Island during turtle season, a risk assessment will be carried out to identify if potentially significant Project-related stressors to marine turtles are present. If significant stressors to marine turtles are identified, these offshore management measures will be considered where practicable: • Vessel movements, including any imposed speed restrictions within the Port of Barrow Island, will be under the control of the Barrow Island Port Captain. • If marine turtles are sighted near the path of a vessel, vessels will divert to avoid them (if safe to do so), or slow down to idling speed. • Vessels working at night within the Port of Barrow Island during turtle season will be required to reduce lighting to the minimum required for safe operations.	Operations
Onshore		
16.	Vehicle traffic on marine turtle nesting beaches will be prohibited unless authorised by CAPL for environmental surveillance, beach clean-up, or in response to an emergency.	All phases
17.	Recreational access to turtle nesting beaches will be prohibited during peak periods of marine turtle nesting and hatching. The period of access restriction may vary seasonally subject to observations of actual peak nesting and hatching activity via the monitoring program outlined in Section 6.0 and/or advice from a subject matter expert with expertise in turtle ecology.	All phases
18.	During turtle season, temporary onshore lighting will be kept to the minimum required for safe operations and, where practicable, will be downward-facing and directed solely onto the work area.	Operations
19.	Permanent onshore task lighting will be normally ‘off’ and will be manually switched ‘on’ to provide the necessary task lighting required when work is taking place.	Operations

Table 5-4: Management Measures (relevant to Marine Turtles) Implemented in other EMPs

EMP[1]	Legislative Requirement	Scope
SLWMP (Ref. 61)	Condition 30 of MS 800 Condition 20 of EPBC Reference: 2003/1294 and 2008/4178	Describes approaches to manage wastes, including wastes from vessels, during construction and operations. These management approaches aim to achieve, where practicable: • collection, storage, and handling of solid wastes to minimise the potential for windblown material reaching coastal or marine environments • no unauthorised overboard disposal of waste from marine vessels • MARPOL compliance (where relevant to the vessel) • management of liquid waste discharges to marine environment (e.g. firewater).
CSMMP[6] (Ref. 8)	Condition 25 of MS 800 Condition 18 of EPBC Reference: 2003/1294 and 2008/4178	Describes approaches to: • ensure the physical presence of marine facilities do not cause significant adverse impacts to the stability of adjacent beaches • detect adverse changes to beach structure/sediments that could have implications for nesting turtles.
TSEPP (Ref. 10)	Condition 7 of MS 800 Condition 6 of EPBC Reference: 2003/1294 and 2008/4178	Describes approaches to manage (among other things) drainage from the GTP, including stormwater run-off during construction and operations. These management approaches, where practicable, aim to: • collect uncontaminated stormwater and redistribute it in a way that minimises channelisation and erosion • segregate, intercept, treat, and/or dispose of streams of potential contamination • prevent, contain, and respond to leaks and spills
AQMP (Ref. 12)	Condition 29 of MS 800	Describes monitoring and management for potential GTP air emissions, including from ground and BOG flares.
MFCEMP (Ref. 11)	Condition 17 of MS 800 Condition 13 of EPBC Reference: 2002/1294 and 2008/4178	Describes management of impacts from the construction of marine facilities, to address aspects including: • turbidity • harm or fatalities to marine turtles and cetaceans • noise and vibration • direct benthic disturbance
DSDMMP[7] (Ref. 60)	Condition 20 of MS 800 Condition 14 of EPBC Reference: 2002/1294 and 2008/4178	Describes marine turtle monitoring and management requirements during construction dredging.
Gorgon DomGas Pipeline Environment Plan – Commissioning,	*Petroleum (Submerged Lands) Act 1982* (WA) *Petroleum Pipelines Act 1969* (WA)	Describes approaches to manage all impacts and risks associated with commissioning, start-up, and operation of the DomGas and Feed Gas Pipeline Systems

[6] State and Commonwealth Ministerial Conditions require MTEP consultation on the development and revision of the CSMMP.

[7] State and Commonwealth Ministerial Conditions require MTEP consultation on the development and revision of the DSDMMP.

EMP[1]	Legislative Requirement	Scope
Start-Up, and Operation (Ref. 19)		
Horizontal Directional Drilling Management and Monitoring Plan (Ref. 69)	Condition 22 of MS 800 Condition 16 of EPBC Reference: 2002/1294 and 2008/4178	Describes approaches to manage all impacts and risks associated with the construction of the shoreline crossing on the west coast of Barrow Island.
Offshore Feed Gas Installation Management Plan (Ref. 70)	Condition 23 of MS 800 Condition 15 of EPBC Reference: 2002/1294 and 2008/4178	Describes approaches to manage all impacts and risks associated with pipeline installation activities.
MEQMP (Ref. 21)	Condition 23A of MS 800	Describes monitoring of the marine environment for effects of waste discharges and inputs on water and sediment quality.

1 EMP titles as amended or supplemented from time to time

6.0 Monitoring Program

The monitoring program defined in this Section has been designed to detect and measure impacts to the Barrow Island Flatback Turtle population. Monitoring site selection was determined based on east coast nesting distribution of the Barrow Island Flatback Turtle population and distance from the Gorgon Gas Development infrastructure and the identified stressors. The beaches identified are considered appropriate for robust modelling of the Flatback Turtle population. In addition to the six monitored beaches, a mainland reference location at Mundabullangana is sampled to allow comparison of regional population trends. To date, more than 9000 individual adult female Flatback Turtles have been tagged at the Barrow Island and Mundabullangana rookeries combined, making this one of the largest and most comprehensive marine turtle capture-mark-recapture programs in the world.

Several factors were considered in the design of this monitoring program, including:

- meeting a statistically valid design
- applying a risk-based approach to determine the suitability of monitoring sites and the quantity and frequency of monitoring
- limiting disturbance to the Flatback Turtle population and monitoring sites
- suitability of parameters for long-term monitoring of population viability
- existing baseline information (Section 3.0)
- outcomes of monitoring during construction (Ref. 13)
- outcomes of the 2015 risk assessment (Section 4.0).

This monitoring program includes, but is not limited to, the monitoring scopes summarised in Table 6-1 to Table 6-3 and provides data for these key demographic parameters:

- adult female survival probability
- adult female breeding omission probability
- egg hatching probability
- hatchling emergence probability
- hatchling disorientation
- hatchling misorientation
- nesting beach abundance
- annual nester abundance
- clutch frequency data.

These key demographic parameters are identified as necessary for understanding the population dynamics and population viability of the Flatback Turtle rookery on Barrow Island (Ref. 63). Where relevant, these data are also captured at the Mundabullangana reference location (or other suitable alternative Flatback Turtle rookery) for comparison with the Barrow Island Flatback Turtle data (Figure 6-1).

Changes in key demographic parameters are measured using time-series control charts, which offer a robust approach to understanding trends in a parameter over time and have been be effective in monitoring key demographic parameters of the Barrow Island Flatback Turtle population since 2009 (Ref. 62; Ref. 13).

Other demographic and biophysical parameters may be collected at Barrow Island and suitable reference locations if required to support diagnosis of Flatback Turtle population trends. These may include, but are not limited to:

- recruitment to the nesting population (neophytes)

- growth rates (curved carapace length [CCL]) of nesting turtles
- tag loss/retention rates in tagged nesting turtles
- evidence of disease (e.g. fibropapillomatosis) in nesting turtles.

The monitoring program will be implemented in a way that meets the objectives defined in Table 6-1 to Table 6-3, while retaining operational flexibility such that abnormal events (e.g. extreme weather events), including those beyond CAPL's control, can be accommodated. If it is not possible to implement or complete one or more monitoring scopes or a component of a scope (e.g. cyclone, safety concerns), CAPL will take measures to ensure the objectives of the monitoring program continue to be met.

Table 6-1: Flatback Turtle Abundance and Distribution

Objective	• To measure and detect changes to the abundance, distribution, and nesting behaviour of adult Flatback Turtles
Method	• Capture-mark-recapture sampling
Parameters	• Adult female survival probability • Adult female breeding omission probability • Annual nester abundance • Nesting activity • Clutch frequency • Internesting interval

Location	• Selected east coast Barrow Island beaches:*
	  • Mushroom
	  • Terminal
	  • Bivalve
	  • Inga
	  • Yacht Club North
	  • Yacht Club South
	• Mundabullangana or other reference location

Frequency	• Annual during peak nesting

** Specific east coast beaches and reference site used for monitoring purposes may vary because of extreme weather events (e.g. cyclones) or safety concerns.*

Table 6-2: Flatback Turtle Incubation Success

Objective	• To measure and detect changes to Flatback Turtle incubation success
Method	• Collection of incubation data from marked nests
Parameters	• Clutch size • Incubation duration • Egg hatching probability • Hatchling emergence probability • Incubation temperature • Clutch fate

Location	• Selected east coast Barrow Island beaches:*
	  • Mushroom
	  • Terminal
	  • Bivalve
	• Mundabullangana or other reference location

Frequency	• Annual during peak nesting

** Specific east coast beaches and reference site used for monitoring purposes may vary because of extreme weather events (e.g. cyclones) or safety concerns.*

Table 6-3: Flatback Turtle Hatchling Orientation

Objective	• To measure and detect variation in dispersal patterns of Flatback Turtle hatchlings following emergence from the nest
Method	• Measures of the orientation of hatchling tracks on beaches
Parameters	• Hatchling emergence fan spread angle • Hatchling emergence fan offset angle (from most direct line to the ocean) • Magnitude and bearing of artificial light emissions (where reasonably necessary to interpret variation in hatchling dispersal patterns on beaches)

Location	• Selected east coast Barrow Island beaches:*
	  • Mushroom
	  • Terminal
	  • Bivalve
	  • Inga
	  • Yacht Club North
	  • Yacht Club South

Frequency	• Annual during peak hatchling emergence

** Specific east coast beaches and reference site used for monitoring purposes may vary because of extreme weather events (e.g. cyclones) or safety concerns.*

Historical monitoring programs and studies that have been concluded are summarised in 12.0Appendix B. Close-out reports for the following historical monitoring programs will be provided to DWER and DotEE by 1 January 2019 (or another date as agreed by DWER and DotEE):

- Marine Turtle Track Census Program (Ref. 71)
- Flatback Turtle Satellite Tracking Program (Ref. 72)
- Beach Temperature Monitoring Program (Ref. 73).

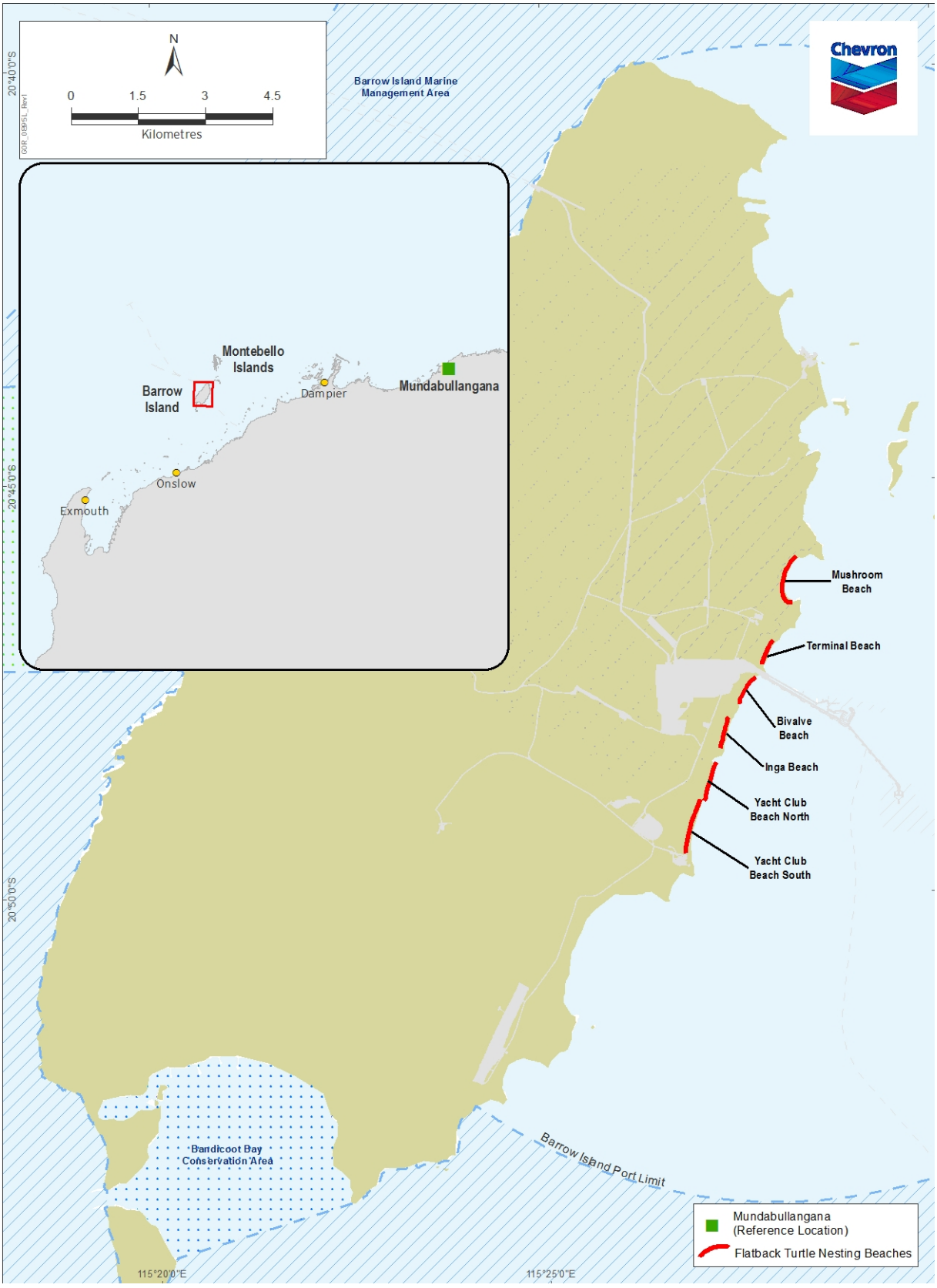

Figure 6-1: Monitored Flatback Turtle Nesting Beaches at Barrow Island and Mundabullangana (Reference Location)

7.0 Scope of Studies

Studies aimed at understanding the ecology of Flatback Turtles or links between stressors and Flatback Turtle behaviour may be initiated by one or more of these pathways:

- **Exceedance of the Environmental Management Triggers**

  Demographic data are compared against the Management Triggers described in Section 8.0. If a Review (±2 statistical deviation) or Action (±3 statistical deviation) Management Trigger is exceeded and the cause is deemed Project-attributable, CAPL will—in consultation with the MTEP—review the requirement to initiate additional studies, as listed in Table 7-1.

- **Exceedance of the CSMMP Marine Turtle Nesting Habitat Management Triggers**

  Measures of optimal nesting habitat are compared against the Marine Turtle Nesting Habitat Management Triggers defined in the CSMMP Supplement: Management Triggers (Ref. 9). If a Marine Turtle Nesting Habitat Alert or Review Management Trigger is exceeded, CAPL—in consultation with the MTEP—may review the requirement to initiate studies, as listed in Table 7-1.

- **Change in Risk Profile for Potentially Significant Stressors**

  Potentially significant stressors to marine turtles associated with the Gorgon Gas Development that were identified—in consultation with the MTEP—and were subject to evaluation by risk assessment, are described in Section 4.0. If a change in risk profile associated with a potentially significant stressor is identified, CAPL—in consultation with the MTEP—may review the requirement to initiate studies, as listed in Table 7-1.

The studies are distinct to the Monitoring Program (Section 6.0); they studies do not aim to measure and detect changes to Flatback Turtle demographic parameters, but to improve the understanding of significant Project-related stressors that have the potential to impact Flatback Turtles at Barrow Island. If the outcomes of a study identify that further information or data collection is required, CAPL may—in consultation with the MTEP—initiate an expansion to the study or modify the monitoring scopes or components of scopes defined in Section 6.0.

The studies listed in Table 7-1 are an example and therefore do not preclude the implementation of other studies that are considered more suitable for addressing knowledge gaps.

Table 7-1: Scope of Studies

Stressor	Scope	Potential Impacts	Management Relevance
Artificial Light	Investigate the effects of offshore artificial light (including light from LNG ships and Condensate vessels) on in-water dispersal, survivorship, and predation of Flatback Turtle hatchlings as they disperse from east coast beaches of Barrow Island	Disorientation or misorientation of hatchlings at sea, increased predation from marine predators attracted to offshore artificial lighting	Improve knowledge of the potential impact of increased offshore light levels on the dispersal and survivorship of Flatback Turtle hatchlings

Stressor	Scope	Potential Impacts	Management Relevance
Artificial Light	Investigate the effects of artificial light on the distribution of adult Flatback Turtle nesting activity on Barrow Island	Nesting adults avoid beaches with increased light levels	Improve knowledge of the potential impact of increased light levels on the distribution of Flatback Turtle nesting activity
Artificial Light	Investigate predation rates of Flatback Turtle eggs and hatchlings on east coast beaches of Barrow Island	Increased predation of eggs and disorientation and predation of hatchlings on beaches with increased levels of artificial light	Improve knowledge of the potential impact of increased artificial light levels on predation rates of Flatback Turtle eggs and hatchlings
Physical presence (of infrastructure)	Investigate the effects of physical presence of infrastructure (MOF causeway, MOF, LNG Jetty) on in-water dispersal, survivorship, and predation of Flatback Turtle hatchlings in east coast waters of Barrow Island	Disruption of hatchling dispersal and survivorship in the nearshore zone, including entrainment in infrastructure, increased predation around the MOF causeway, MOF, and LNG Jetty	Improve knowledge of the potential impact of the physical presence of infrastructure on the dispersal and survivorship of Flatback Turtle hatchlings near the MOF causeway, MOF, and LNG Jetty
Physical presence (of infrastructure)	Investigate the effects of the physical presence of infrastructure (MOF causeway, MOF,LNG Jetty) on the quality and availability of Flatback Turtle nesting habitat on east coast beaches of Barrow Island	Reduced nesting and incubation success, increased disturbance of clutches due to increased density of nesting adults, nesting adults avoiding beaches of lower quality nesting habitat, use of lower quality nesting habitat on other beaches	Improve knowledge of the potential impact of changes in the quality and availability of nesting habitat on incubation success and the distribution of Flatback Turtle nesting activity on Barrow Island
Physical presence (of infrastructure)	Investigate the pivotal temperature and thermal tolerance range of Flatback Turtle embryos on Barrow Island	Changes in nesting habitat may alter thermal characteristics of nest environment with implications for embryonic development	Improve knowledge of the potential impact of changes in nesting habitat on incubation success and embryonic development
Vibration	Investigate if vibration levels from onshore seismic activities can be detected above ambient levels on Terminal Beach and Mushroom Beach on the east coast of Barrow Island	Disturbance of eggs and embryonic development, misorientation and disorientation of hatchlings	Determine if vibration from onshore seismic activity can be detected above ambient levels, and if vibration poses a risk to Flatback Turtle egg development or hatchling dispersal
Noise	Investigate if noise levels from onshore Gorgon Gas Development activities can be detected above ambient levels on selected east coast Flatback Turtle nesting beaches of Barrow Island	Nesting adults may avoid beaches with increased noise levels, disorientation and misorientation of hatchlings	Determine if noise from Gorgon Gas Development activities can be detected above ambient levels, and if noise poses a risk to nesting adult Flatback Turtles or hatchling dispersal

Stressor	Scope	Potential Impacts	Management Relevance
Noise	Investigate underwater noise contours related to important marine turtle internesting habitat in east coast waters of Barrow Island	Noise impacts may deter usage of internesting habitat	Improve knowledge of underwater noise levels in relation to marine turtle internesting habitat
Physical interaction	Identify important Flatback Turtle marine habitat	Vessel activity in Flatback Turtle marine habitat may increase risk to marine turtles through physical interaction	Improve knowledge of important Flatback Turtle habitat if there is a potential risk of physical interaction
Solid and liquid waste discharges to sea	Investigate toxicology levels in marine turtles on east coast beaches and waters of Barrow Island	Changes in pollutant or toxicological parameters may result in negative health impacts on marine turtles	Improve knowledge of marine turtle health and support interpretation of changes to survivorship or incubation success
Leaks or spills (loss of containment, unplanned discharges to sea or on turtle nesting) beaches)	Investigate toxicology levels in marine turtles on east coast beaches and waters of Barrow Island	Changes in pollutant or toxicological parameters may result in negative health impacts on marine turtles	Improve knowledge of marine turtle health and support interpretation of changes to survivorship or incubation success

8.0 Environmental Management Triggers

Control charts provided in Appendix A are used to track changes in Flatback Turtle key demographic parameters listed in Section 6.0. Trends identified in control charts act as early warning signals to guide a tiered management approach (Figure 8-1).

Management triggers were established based on statistical deviations from the baseline conditions for each demographic parameter. Each trigger is represented as a trend towards, or change beyond, a ±1, ±2, or ±3 statistical deviation (standard deviation [SD], standard error [SE] or median absolute deviation from median [MAD]) from baseline conditions (Figure 8-1):

- Alert: A trend towards the ±1 statistical deviation limit for two consecutive years, or, a change beyond ±1 statistical deviation from baseline conditions
- Review: A change beyond ±2 statistical deviation from baseline conditions
- Action: A change beyond ±3 statistical deviation from baseline conditions.

These ±1, ±2, or ±3 statistical deviation bands approximate a statistical power 0.8 (or greater) to detect changes or impacts to demographic parameters related to population viability (Ref. 62; Ref. 63).

Demographic data are compared against the Management Triggers annually. The aim of the initial response to activation of any management trigger is to determine whether the cause is Project-attributable. If deemed Project-attributable, CAPL, in consultation with the MTEP, will initiate the associated response actions defined in Figure 8-1 according to the level of trigger activated.

Activation of an Action management trigger initiates an immediate investigation into the cause.

The tiered approach described in Figure 8-1 does not preclude early management action if a trigger is determined to be attributable to a stressor from the Gorgon Gas Development and/or represents a significant threat to the viability of the Barrow Island Flatback Turtle population.

The CSMMP Supplement: Management Triggers (Ref. 9) describes the Marine Turtle Nesting Habitat Management Triggers related to detecting adverse changes to optimal nesting habitat that could have implications for marine turtle nesting. Exceedance of CSMMP Marine Turtle Nesting Habitat Management Triggers initiates a response, similar to those defined in Figure 8-1, which may include further analysis or initiation of studies described in Section 7.0.

As described in Section 1.5, a review of the baseline control charts will be conducted prior to 1 January 2019 (or as agreed with DWER and DotEE), and may require an update to management triggers.

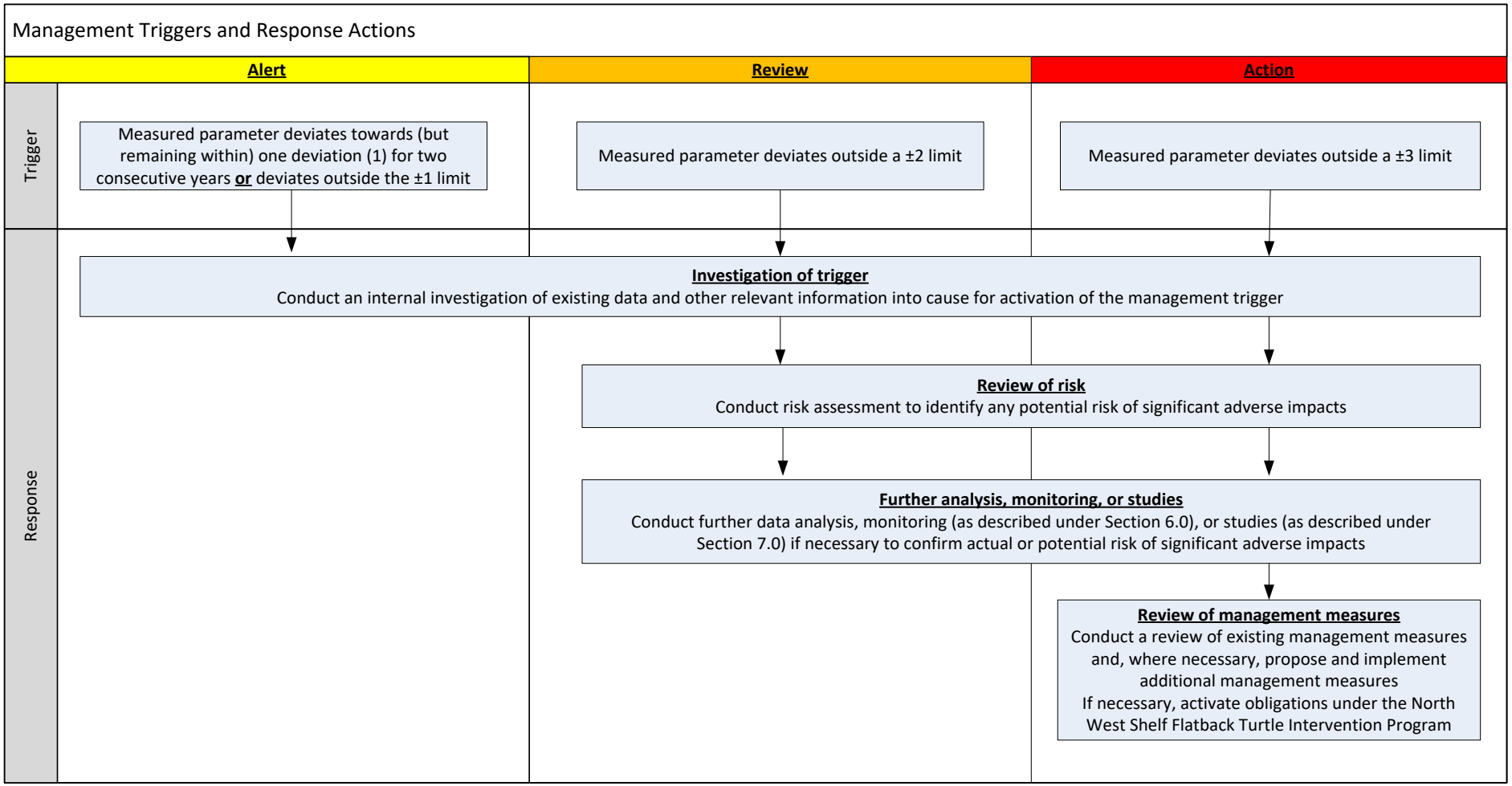

Figure 8-1: Management Triggers and Response Actions

9.0 Performance Objectives and Standards

Environmental performance is 'the measurable results of an organisation's management of its environmental aspects' (Ref. 66). CAPL measures environmental performance through:

- **Environmental Performance Objectives** – the objectives of the Plan as defined by Condition 16.3 of MS 800 and Condition 12.3 of EPBC Reference: 2003/1294 and 2008/4178
- **Environmental Performance Standards** – defined, in accordance with Schedule 2 of MS 800, as 'matters which are developed for assessing performance, not compliance, and are quantitative targets or where that is demonstrated to be not practicable, qualitative targets, against which progress towards achievement of the objectives of conditions can be measured'.

Table 9-1 lists the environmental performance objectives and standards that were developed to enable CAPL to assess environmental performance for managing marine turtle populations and Project stressors.

The standards in Table 9-1 were developed for assessing performance, not compliance. Failure to meet the standards does not represent failure to implement this Plan; rather, it indicates that a performance objective may not have been met and management action or a review of the environmental performance objectives and standards may be needed.

The objective to '*establish baseline information on the populations of marine turtles that utilise the beaches adjacent to the east coast facilities*' as per Condition 16.3.ii of MS 800 and Condition 12.3.ii EPBC 2003/1294 and 2008/4178, is not included in Table 9-1 as that objective has already been met. The marine turtle populations on the east coast of Barrow Island were characterised before construction of the Gorgon Gas Development terrestrial and marine facilities commenced on the east coast (see Section 3.0 and Appendix A). No further assessment of environmental performance against this objective is required.

Table 9-1: Objectives and Performance Standards

Objectives	Performance Standards
Address the long-term management of the marine turtles that utilise the east coast beaches and waters where there are Proposal-related stressors to marine turtles	1. Risks from Project stressors (including artificial light and noise emissions) are reduced to ALARP in areas that may affect the east coast beaches and waters of Barrow Island. 2. Outcomes of studies initiated by response actions to a CSMMP Marine Turtle Nesting Habitat Management Trigger (Ref. 9): a. inform whether changes to optimal nesting habitat represent implications for Flatback Turtles on Barrow Island b. identify recommended management actions. 3. Outcomes of the response actions to Management Triggers (Section 8.0): a. identify the cause of the deviation in a demographic parameter b. confirm risk status for a potential significant adverse impact to marine turtle populations (Review and Action triggers only) c. identify recommended management actions (Action trigger only).
Specify design features, management measures and operating controls to manage, and where practicable, avoid adverse impacts to marine turtles, with specific reference to reducing light and noise emissions as far as practicable	

Objectives	Performance Standards
Establish a Monitoring Program to measure and detect changes to the Flatback Turtle population	4. Implement the monitoring program to measure the demographic parameters listed in Section 6.0 for Flatback Turtles on Barrow Island. 5. Control charts are updated annually to track trends in the demographic parameters listed in Section 6.0 for Flatback Turtles on Barrow Island to determine variation from the baseline conditions.

10.0 Incident Reporting

Table 10-1 lists the environmental incident reporting requirements, including timing, specific to this Plan.

Table 10-1: Incident Reporting Requirements

Incident	Report to	Timing
Harm or mortality to listed marine turtles attributable to the Gorgon Gas Development	DotEE and DBCA	Within 24 hours of detection
Significant impacts detected by the monitoring program on matters of NES relevant to this Plan (Table 3-1)	DotEE	Within 48 hours of detection

11.0 Terminology

Terminology used in this document is listed in Table 11-1. These terms align with those defined in:

- Schedule 2 of MS 800
- EPBC Reference: 2003/1294 and 2008/4178.

Table 11-1: Terminology

Term	Definition
°C	Degrees Celsius
Adult	A fully developed and mature turtle, physically capable of breeding, but not necessarily doing so until social and/or ecological conditions allow
Adult female breeding omission probability	Annual probability estimate of skipped breeding for adult female marine turtle nesters in a nesting population
Adult female survival probability	Annual estimated survival rate for adult female marine turtle nesters in a nesting population
ALARP	As Low As Reasonably Practicable – if it is demonstrated that the cost of implementing further control measures is disproportionate to the benefit gained, the risk is considered to be as low as reasonably practicable. Cost includes financial cost, time or duration, effort, occupational health and safety risks, or environmental impacts associated with implementing the control.
Annual nester abundance	Estimate of total female marine turtle nesters per season at a rookery
AQMP	Air Quality Management Plan
Benthic	Living upon or in the sediment of the sea
BOG	Boil-off Gas; vapours produced as a result of heat input and pressure variations that occur during various LNG storage and offloading operations stages
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals 1979
Butler Park	Gorgon Construction and Operations workforce primary accommodation facilities
Caisson	A large watertight chamber used for construction under water
CAPL	Chevron Australia Pty Ltd. On behalf of the Gorgon Joint Venture Partners, CAPL will implement this Plan.
Carapace	The top surface of a turtle's shell
Carbon Dioxide Injection System	The mechanical components required to be constructed to enable the injection of reservoir carbon dioxide, including but not limited to compressors, pipelines, and wells
CCL	Curved Carapace Length. Length of a turtle's carapace measured by researchers along the long axis with a flexible tape measure
Clutch frequency	The mean number of clutches laid per female marine turtle nester per season
cm	Centimetre
CO_2	Carbon dioxide
Construction	As defined in MS 800, construction includes any Proposal-related (or action-related) construction and commissioning activities within the Terrestrial and Marine Disturbance Footprints, excluding investigatory works such as, but not limited to, geotechnical, geophysical, biological and cultural heritage surveys, baseline monitoring surveys, and technology trials.

Term	Definition
Construction Period	As defined in MS 800, the period from the date on which the Gorgon Joint Venturers commence construction of the Proposal until the date on which the Gorgon Joint Venturers issue a notice of acceptance of work under the Engineering, Procurement and Construction Management (EPCM), or equivalent contract entered into in respect of the second LNG train of the GTP.
CRI	Colour Rendition Index
CSMMP	Coastal Stability Management and Monitoring Plan
Cth	Commonwealth of Australia
DBCA	Western Australian Department of Biodiversity Conservation and Attractions
Disorientation	Where hatchlings or adults crawl on circuitous paths
DNA	Deoxyribonucleic acid
DomGas	Domestic Gas
DotEE	Commonwealth Department of the Environment and Energy
DSDMMP	Dredging and Spoil Disposal Management and Monitoring Plan
DWER	Western Australian Department of Water and Environmental Regulation
Egg hatching probability	Estimated annual marine turtle egg hatching rate. For this Plan, it is defined as the number of hatched eggs as a percentage of the total clutch count at excavation of a monitored clutch.
Embryo	Time period from the first cell division until hatching
EMP	Environmental Management Plan
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPBC Reference: 2003/1294	Commonwealth Ministerial Approval (for the Gorgon Gas Development) as amended or replaced from time to time.
EPBC Reference: 2005/2184	Commonwealth Ministerial Approval (for the Jansz Feed Gas Pipeline) as amended or replaced from time to time.
EPBC Reference: 2008/4178	Commonwealth Ministerial Approval (for the Revised Gorgon Gas Development) as amended or replaced from time to time.
EPBC Reference: 2011/5942	Commonwealth Ministerial Approval (for the Fourth Train Expansion) as amended or replaced from time to time.
EPCM	Engineering, Procurement, and Construction Management
ESD	Emergency Shutdown
F/f	Flatback Turtle. Capital letter indicates greater potential impact/risk.
Feed Gas Pipeline	Pipeline from the wells to the GTP
G/g	Green Turtle. Capital letter indicates greater potential impact/risk.
Gorgon Gas Development	The Gorgon Gas Development as approved under MS 800, MS 965 and EPBC Reference: 2003/1294 and 2008/4178, as amended or replaced from time to time.
GTP	Gas Treatment Plant
H/h	Hawksbill Turtle. Capital letter indicates greater potential impact/risk.
Hatchling	Newly hatched marine turtle. The hatchling phase is the period between the hatchling emerging from the egg shell and moving to nearshore foraging grounds on a continental shelf. During this phase, the hatchling uncurls and absorbs the egg yolk as it emerges onto the beach surface, crawls across the beach, swims to the nearshore foraging grounds (swimming frenzy), and commences feeding when reliance on the egg yolk has ceased.

Term	Definition
Hatchling disorientation	The range of dispersion (nest fan spread angle) of marine turtle hatchling tracks from the emergence point.
Hatchling emergence probability	Estimated annual marine turtle hatchling emergence rate. For this Plan, it is defined as the number of hatched eggs minus the number of dead or live hatchlings in the nest, as a percentage of the total clutch count at excavation of a monitored clutch.
Hatchling misorientation	The degree of deflection (nest fan offset angle) of marine turtle hatchling tracks from the most direct line to the ocean
Internesting Interval	Period between a successful nest and subsequent nest or nesting attempt in a single breeding season. The females move to offshore internesting grounds while they form the next clutch of eggs. Internesting grounds may be close to or remote from the nesting beach.
Internesting Period	Period between successive oviposition (egg laying) events in a single breeding season
IOSEA Marine Turtle MOU	Memorandum of Understanding on the Conservation of Sea Turtles and their Habitats in the Indian Ocean and South-East Asia (http://www.ioseaturtles.org)
IUCN	International Union for Conservation of Nature
Jansz Feed Gas Pipeline	The Jansz Feed Gas Pipeline as approved in MS 769 and EPBC Reference: 2005/2184, as amended or replaced from time to time.
Juvenile	Benthic small immature turtles, typically up to CCL = 60 cm for Hawksbill and Flatback Turtles or CCL = 65 cm for Green Turtles. These size estimates refer to approximately the middle size between the end of recruitment from the post-hatchling phase and sub-adult.
km	Kilometre
km/h	Kilometres per hour
LED	Light-emitting Diode; a semiconductor device that emits incoherent narrow-spectrum light
Light Spill	Brightening of the environment from light directly observable from the source
LNG	Liquefied Natural Gas
Luminaire	A complete lighting unit that produces and distributes light, including the fixture, ballast, mounting, and lamps
m	Metre
m/s	Metres per second
MAD	Median Absolute Deviation (from median)
Management Triggers	As defined in MS 800, are quantitative, or if this is demonstrated to be not practicable, qualitative matters above or below whichever relevant additional management measures must be considered

Term	Definition
Marine Facilities	In relation to MS 800 and EPBC Reference: 2003/1294 and 2008/4178, the Marine Facilities are the: • Materials Offloading Facility (MOF) • LNG Jetty • Dredge Spoil Disposal Ground • Offshore Feed Gas Pipeline System and marine component of the shore crossing • Domestic Gas Pipeline. For the purposes of MS 800, Marine Facilities also include: • Marine upgrade of the existing WAPET Landing. In relation to MS 769, Marine Facilities are the Offshore Feed Gas Pipeline System and marine component of the shore crossing.
Marine Turtles	For this Plan, refers to Flatback, Green, and Hawksbill Turtles that use the beaches and waters of Barrow Island
MARPOL	The International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
MEG	Monoethylene glycol
MEQMP	Marine Environmental Quality Management Plan
MFCEMP	Marine Facilities Construction Environment Management Plan
MFO	Marine Fauna Observer
Misorientation	Where hatchlings move towards land, possibly attracted to artificial lights
mm	Millimetre
MOF	Materials Offloading Facility
MS	(Western Australian) Ministerial Statement
MS 1002	Western Australian Ministerial Statement 1002, issued for the Gorgon Gas Development Fourth Train Expansion Proposal, as amended from time to time.
MS 748	Western Australian Ministerial Statement 748 (for the Gorgon Gas Development), as amended from time to time [superseded by MS 800].
MS 769	Western Australian Ministerial Statement 769 (for the Jansz Feed Gas Pipeline), as amended from time to time.
MS 800	Western Australian Ministerial Statement 800 (for the Gorgon Gas Development), as amended from time to time.
MS 865	Western Australian Ministerial Statement 865, issued to establish a restart mechanism for dredging, as amended from time to time.
MS 965	Western Australian Ministerial Statement 965, issued for the Additional Construction Laydown and Operations Support Area, as amended from time to time.
MS 1002	Western Australian Ministerial Statement 1002, issued for the Fourth Train Expansion Proposal, as amended from time to time.
MTEP	Marine Turtle Expert Panel (established under Condition 15 of MS 800)
n	Number
N/A	Not Applicable
Natal Beach	Beach on which a marine turtle hatches and first enters the sea
Nearshore	Within three nautical miles of Barrow Island
NES	[Matters of] National Environmental Significance, as defined in Part 3, Division 1 of the EPBC Act (Cth)

Term	Definition
Nesting beach abundance	A relative annual index of marine turtle nester abundance on a nesting beach based on daily track count data.
nm	Nanometre
Offshore	Below the water level at low tide
Onshore	Above the water level at low tide
Operations (Gorgon Gas Development)	In relation to MS 800 and EPBC Reference: 2003/1294 and 2008/4178, for the respective LNG trains, this is the period from the date on which the Gorgon Joint Venturers issue a notice of acceptance of work under the EPCM contract, or equivalent contract entered into in respect of that LNG train of the GTP; until the date on which the Gorgon Joint Venturers commence decommissioning of that LNG train.
Operations (Jansz Feed Gas Pipeline)	In relation to MS 769, for the pipeline, this is the period from the date on which the Proponent issues a notice of acceptance of work under the EPCM contract, or equivalent contract entered into in respect of that pipeline; until the date on which the Proponent commences decommissioning of that pipeline.
Operations Workforce Accommodation	As defined in MS 800, refers to accommodation within an extension to the existing Chevron Camp
Optimal nesting habitat	Optimal nesting habitat is a nesting habitat zone where characteristics of measured physical parameters within the study area are considered ideal for marine turtle nesting.
Peak Hatching	For this Plan, is the peak seasonal period of marine turtle hatchling emergence on Barrow Island beaches. This is typically between February and March for Flatback and Green Turtles.
Peak Nesting	For this Plan, is the peak seasonal period of marine turtle nesting on Barrow Island beaches. This is typically between November and January for Flatback Turtles, and December and February for Green Turtles.
Performance Standards	Developed for assessing performance, not compliance, and are quantitative targets or if that is demonstrated to be not practicable, qualitative targets, against which progress towards achievement of the objectives of conditions can be measured
PIT	Passive integrated transponder; an electronic tag with no internal power source that is activated by an applied electromagnetic field to transmit a unique coded message (= tag number)
Population	The summation of individuals of a species within a defined geographic area. For this Plan, Flatback Turtles that utilise the east coast beaches (nesting females and hatchlings) and waters (all age classes) of Barrow Island
Post-hatchling	A marine turtle immediately after it has completed the hatchling phase. In Green, Loggerhead, and some Hawksbill Turtles, this stage is pelagic, occurs in deep offshore oceanic waters, and lasts ~10 years. In Flatback Turtles, this occurs as a pelagic neritic stage; duration is not known. Post-hatchlings are generally <50 cm CCL.
Practicable	Means reasonably practicable having regard to, among other things, local conditions and circumstances (including costs), and to the current state of technical knowledge.
Project	Gorgon Gas Development
Ra	Unit used for Colour Rendition Index
Region	The summation of individuals of a species that might comprise one or more populations and that typically share a geographically defined area and have the potential to interbreed. For this Plan, refers to Flatback Turtles from the wider Pilbara and Kimberley areas

Term	Definition
Remigration interval	The frequency (in years) between breeding seasons at which marine turtles return to the nesting ground to reproduce
RO	Reverse Osmosis
Rookery	A turtle nesting beach or grouping of beaches
s	Second (time)
SCL	Straight-line Carapace Length; straight-line measurements taken between the leading edge of the nuchal scute to the anterior edge of the carapace (same positions on a turtle carapace as for CCL)
SD	Relating to statistical variation: Standard Deviation. A measure that is used to quantify the amount of variation or dispersion of a set of data values
SE	Relating to statistical variation: Standard Error. A measure that is used to quantify the accuracy with which a sample mean represents a population mean
Seagrass	Unrelated to seaweed, seagrasses are the flowering plants of the ocean, having roots, stems, leaves, and inconspicuous flowers with fruits and seeds
Shallow Coastal Waters	Incorporates the waters of the Australian continental shelf, extending to a maximum depth of 150 m, but typically <50 m near Barrow Island
Shrouding	In relation to lights, structures that envelope or obscure a luminaire; a protective casing or cover
Significant Impact	An impact on a Matter of NES or their habitat, relevant to EPBC Reference: 2003/1294, 2005/2185, and 2008/4178 that is important, notable, or of consequence having regard to its context or intensity.
SLWMP	Solid and Liquid Waste Management Plan
State Waters	The marine environment within three nautical miles of the coast of Barrow Island or the WA mainland
Stock	Genetically similar breeding aggregations of Flatback Turtles that may incorporate one or more separate populations
TAPL	Texaco Australia Pty Ltd
Terrestrial Facilities	In relation to MS 800 and EPBC Reference: 2003/1294 and 2008/4178, the terrestrial facilities are the: • Gas Treatment Plant • Carbon Dioxide Injection System • Associated Terrestrial Infrastructure forming part of the Proposal • Areas impacted for seismic data acquisition • Onshore Feed Gas Pipeline System and terrestrial component of the Shore Crossing. In relation to MS 769, terrestrial facilities are the Onshore Feed Gas Pipeline System and terrestrial component of the Shore Crossing, as approved under MS 769.
TSEPP	Terrestrial and Subterranean Environment Protection Plan
Turtle Season	Period of high marine turtle activity, typically from September to March. This encompasses peak periods of marine turtle mating, nesting, and hatching at Barrow Island.
Vessel	Project vessels (excluding LNG ships and Condensate vessels).
WA	Western Australia
WAPET	Western Australian Petroleum
WAPET Landing	Proper name referring to the site of the barge landing existing on the east coast of Barrow Island prior to the date of MS 800

Term	Definition
Waters Surrounding Barrow Island	As defined in MS 800, refers to the waters of the Barrow Island Marine Park and Barrow Island Marine Management Area (approximately 4169 ha and 114 693 ha respectively) as well as the Port of Barrow Island representing the Pilbara Offshore Marine Bioregion, which is dominated by tropical species that are biologically connected to more northern areas by the Leeuwin Current and the Indonesian Throughflow, resulting in a diverse marine biota is typical of the Indo–West Pacific flora and fauna.

12.0 References

The following documentation is directly referenced in this document.

Table 12-1: References

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Appendix A Summary of Baseline Information

Species Common Name (receptor)	Baseline Period	Parameter	Sample Size (n)	Annual Mean	SD(±)	Range
Flatback (nesting adults)	2005–2006 to 2009–2010	internesting interval (days)	2841	14.1	2.3	7–22
		remigration interval (years)	3234	1.7	0.8	1–10
		growth rates (cm/year)	1725	0.59	0.59	0.01–4.67
		CCL (mm)	6498	89.8	2.7	77.5–99
	2008–2009 to 2009–2010	tag loss (titanium flipper tag, %)	2	5.0	0.1	4.9–5.0
	2009–2010	tag loss (passive integrated transponder [PIT] tag, %)	1	0	-	-
		evidence of disease (fibropapillomatosis)	No evidence of disease			
Flatback (eggs)	2006–2007 to 2009–2010	incubation duration (days)	144	46.8	10.1	14–74
		clutch size	72	48.5	2.6	44–55
		egg size (diameter, mm)	9	49.6	1.4	47.5–51.2
		egg weight (grams)	70	67.7	12.4	42.1–59.9
		live hatchling size (straight-line carapace [SCL], mm)	41	56.7	1.9	53.7–61.1
		live hatchling weight (grams)	41	35.8	3.7	27.1–43.3
		incubation temperature	30	32.4	1.0	30.8–34.4
Flatback Green (hatchlings)	2005–2006 to 2009–2010	hatchling emergence fan spread angle (°) Flatback Turtle clutches	1550	52.0	22.6	1–164
		hatchling emergence fan offset angle (°) Flatback Turtle clutches	1550	8.6	8.8	0–109
		hatchling emergence fan spread angle (°) Green Turtle clutches	260	62.1	33.6	5–182
		hatchling emergence fan offset angle (°) Green Turtle clutches	260	19.9	21.6	0–142

Species Common Name (receptor)	Baseline Period	Parameter	Sample Size (n)	Annual Mean	SD(±)	Range
Flatback (internesting and post-nesting adults)	2009–2010	internesting interval of tracked turtles (days)	44	13.4	1.3	11–17
		habitat use (internesting) total distance travelled (km)	44	90.1	48.4	34.9–242.3
		habitat use (internesting) daily distance travelled (km/day)	44	8.1	3.5	3.7–17.5
		habitat use (internesting) speed (km/day)	44	4.1	3.1	1.0–10.8
		water temperature (°C) (internesting depth range: 1–18 m)	44	27.7	0.6	26–31
		bathymetry (m)	1598	9.9	4.2	0.0–19.6
		habitat use (post-nesting) total distance travelled (km)	19	2888.9	1944	298.9–6230.2
		habitat use (post-nesting) speed (km/h)	19	0.6	0.2	0.3–0.8
		habitat use (post-nesting) dive depth (m)	19	32.8	12.4	15.5–47.9
		habitat use (post-nesting) dive duration (s)	19	2122.1	471.9	1214–3054.8
		water temperature (°C) (post-nesting depth range 0–99 m)	19	27.8	1.4	26–30.8
Flatback (hatchlings)	2009–2010	hatchling swim speed (m/s)	17	0.33	0.16	0.07–0.75
Flatback Green Hawksbill (nesting adults)	2004–2005 to 2009–2010	number of overnight Flatback Turtle tracks on key (index) nesting beaches	611	6.1	11.9	0–137
		number of overnight Green Turtle tracks on key (index) nesting beaches	819	10.3	17.6	0–132
		number of overnight Hawksbill Turtle tracks on key (index) nesting beaches	N/A	N/A	N/A	N/A

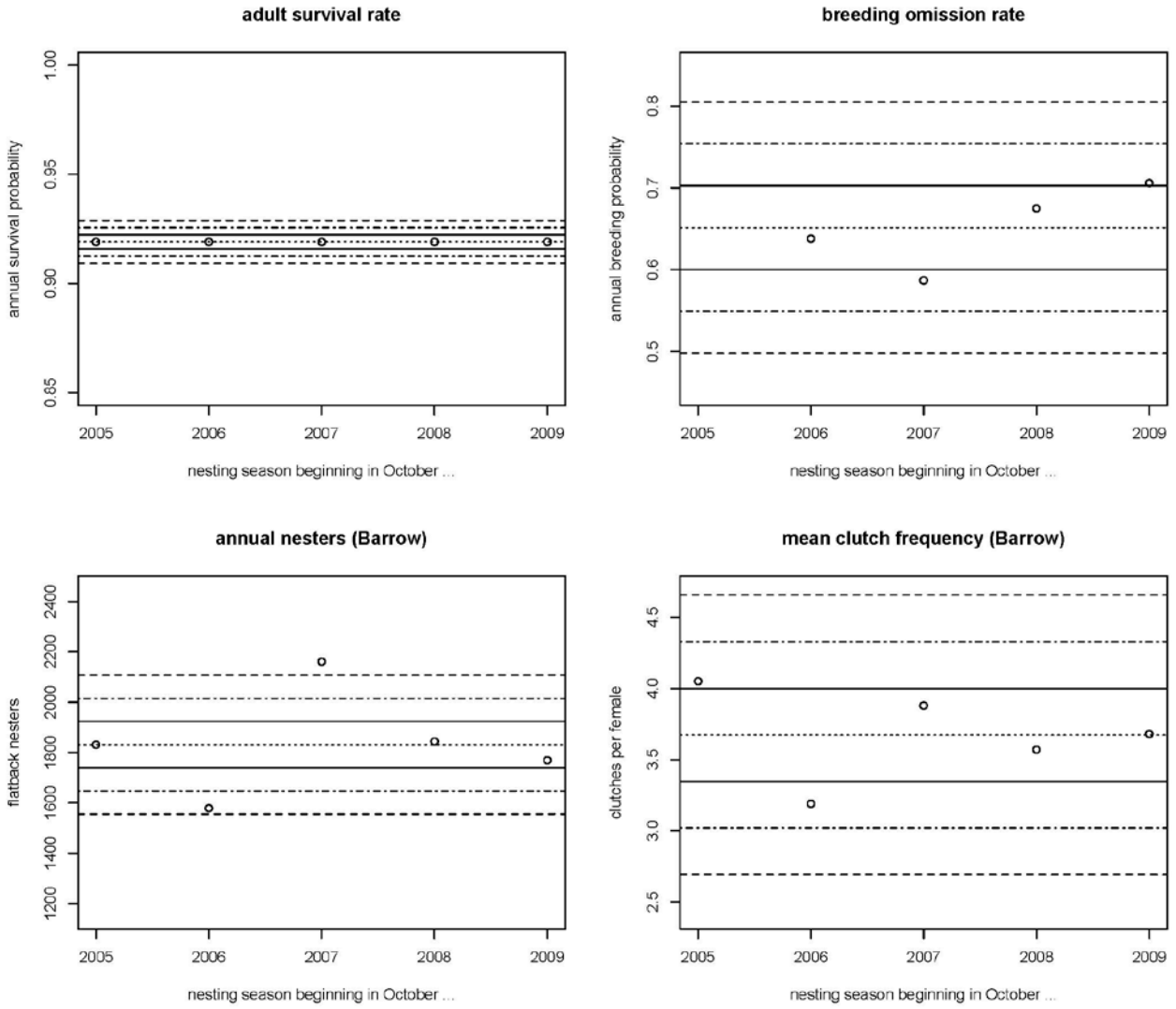

Figure A-1 Statistical control charts for key demographic parameters of the Barrow Island Flatback Turtle population

Open dots = baseline estimate derived from empirical data, dotted horizontal line = long-term expected estimate derived from baseline estimates (mean or median), solid lines = ±1SD (or SE for parameter estimates or median absolute deviations from median [MAD] for nesters), dot-dashed lines = ±2SD (or SE), dashed lines = ±3SD (or SE). The annual nesters panel uses the median/MAD control limit estimator. X-axis – data points each year refer to the season for that year and subsequent year e.g. 2009 refers to the 2009–2010 season (Ref. 36)

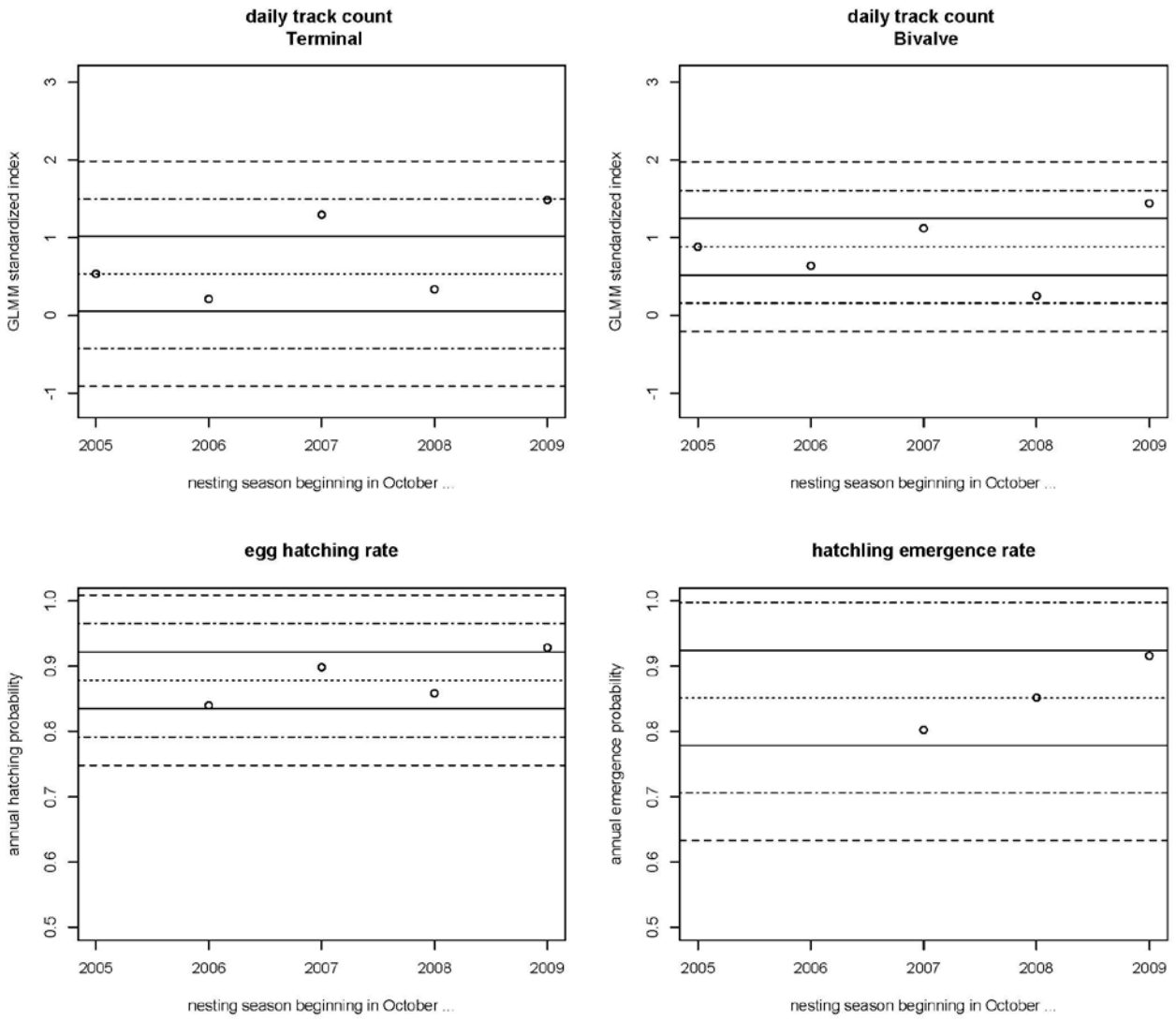

Figure A-2 Statistical control charts for key demographic parameters of the Barrow Island Flatback Turtle population

Open dots = baseline estimate derived from empirical data, dotted horizontal line = long-term expected estimate derived from baseline estimates (mean or median), solid lines = ±1SD (or MAD, dot-dashed lines = ±2SD (or MAD), dashed lines = ±3SD (or MAD). The daily track count index panel uses the median/MAD control limit estimator. X-axis – data points each year refer to the season for that year and subsequent year e.g. 2009 refers to the 2009–2010 season (Ref. 36)

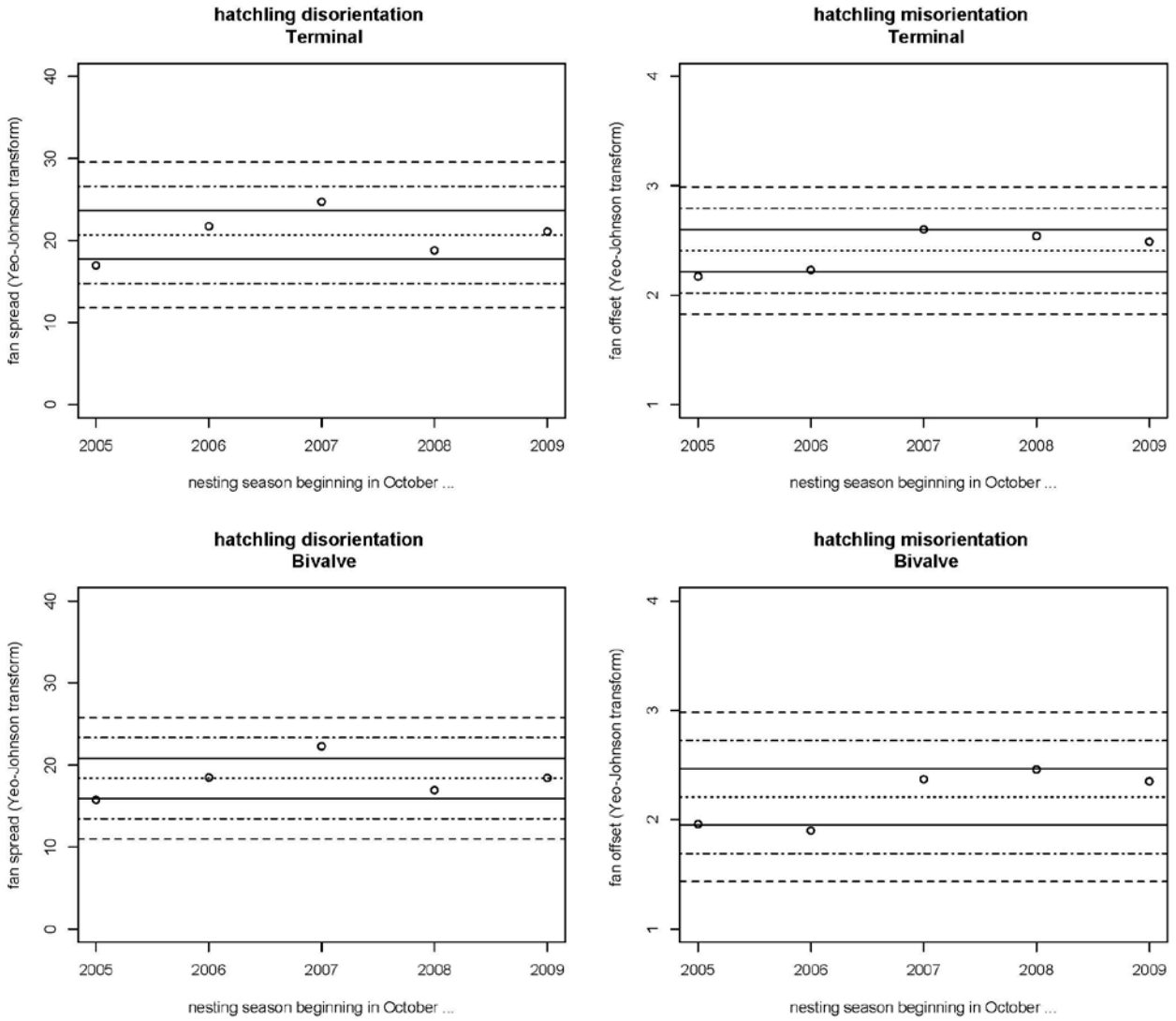

Figure A-3 Statistical control charts for key demographic parameters of the Barrow Island Flatback Turtle population

Open dots = baseline estimate derived from empirical data, dotted horizontal line = long-term expected estimate derived from baseline estimates (mean), solid lines = ±1SD, dot-dashed lines = ±2SD, dashed lines = ±3SD. X-axis – data points each year refer to the season for that year and subsequent year e.g. 2009 refers to the 2009–2010 season (Ref. 36).

Appendix B Historical Monitoring Programs

Program	Duration	Outcome Summary
Marine Turtle Track Census Program	2008–2015	Program concluded. Reasons: • Annual monitoring (since 2008–2009) has established the distribution of marine turtle (Green, Flatback, Hawksbill Turtle) nesting activity on all Barrow Island beaches. • Nester abundance and distribution data will continue to be captured on key Flatback Turtle nesting beaches as part of the long-term Flatback Turtle Abundance and Distribution monitoring scope (Table 6-1), which provides the necessary data for most of the key demographic parameters required for understanding the population dynamics and long-term viability of the Flatback Turtle Population.
Flatback Turtle Satellite Tracking Program	2009–2015	Program concluded. Reasons: • Monitoring has not detected an adverse impact to internesting behaviour of Flatback Turtles attributable to Project dredging activities or offshore vessel use. • The objectives of the Program have been met as monitoring identified spatial behaviour (internesting habitat, beach fidelity, home range, and time–depth behaviour of female adult Flatback Turtles) before and during dredging and construction activities. • The size of the construction vessel fleet and overall vessel activity reduced considerably as marine construction neared completion.
Noise and Vibration Monitoring Program	2009–2015	Program concluded. Reasons: • Flatback Turtle monitoring has shown no detectable adverse impact from noise or vibration on the Flatback Turtle population (including adult nester distribution, abundance, incubation success, or hatchling orientation) at Barrow Island during the construction period. • Noise and vibration monitoring on selected east coast Flatback Turtle nesting beaches during the construction period demonstrated that Project noise and vibration was not detectable above natural ambient conditions.
Beach Temperature Monitoring Program	2009–2015	Program concluded. Reasons: • Annual monitoring of sand temperature since 2004–2005 has shown spatial and temporal variation in beach sand temperature. Results have demonstrated a strong correlation between beach sand temperature and prevailing air temperature. Therefore, air temperature is considered a suitable proxy for estimating beach sand temperature at marine turtle nest depths in future, if required to interpret changes in incubation success. • No adverse impacts from temperature on hatching success or hatchling emergence was observed.
Strandings Monitoring Program	2009–2015 (reported via wildlife management database)	Program concluded. Reasons: • Recording and reporting of all marine turtle strandings is addressed in the Incident Reporting Section (Section 10.0). • Any strandings, including those detected on Flatback Turtle nesting beaches, during the tagging program and other monitoring scopes, are routinely reported in line with incident reporting requirements.

Appendix C Chevron Integrated Risk Prioritization Matrix

Chevron Integrated Risk Prioritization Matrix

For the Assessment of HES & Asset Risks from Event or Activity

Likelihood Descriptions & Index (with confirmed safeguards)

Likelihood Descriptions	Likelihood Indices		Legend
Consequence can reasonably be expected to occur in life of facility	1	Likely	6 5 4 3 2 1
Conditions may allow the consequence to occur at the facility during its lifetime, or the event has occurred within the Business Unit	2	Occasional	7 6 5 4 3 2
Exceptional conditions may allow consequences to occur within the facility lifetime, or has occurred within the OPCO	3	Seldom	8 7 6 5 4 3
Reasonable to expect that the consequence will not occur at this facility. Has occurred several times in industry, but not in OPCO	4	Unlikely	9 8 7 6 5 4
Has occurred once or twice within industry	5	Remote	10 9 8 7 6 5
Rare or unheard of	6	Rare	10 10 9 8 7 6

Decreasing Likelihood

Legend applies to identified HES risks
(see guidance documents for additional explanations)

1, 2 , 3, 4 - Short-term, interim risk reduction required. Long term risk reduction plan must be developed and implemented.

5 - Additional long term risk reduction required. If no further action can be reasonably taken, SBU management approval must be sought to continue the activity.

6 - Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant requirements of the Risk Mitigation Closure Guidelines.

7, 8, 9, 10 - Manage risk. No further risk reduction required. Risk reduction at management / team discretion.

Consequence Descriptions & Index (without safeguards)

Decreasing Consequence/Impact

Consequence Descriptions	Consequence Indices	6 Incidental	5 Minor	4 Moderate	3 Major	2 Severe	1 Catastrophic
Safety		**Workforce:** Minor injury such as a first-aid. *AND* **Public**: No impact	**Workforce:** One or more injuries, not severe. *OR* **Public**: One or more minor injuries such as a first-aid.	**Workforce**: One or more severe injuries including permanently disabling injuries. *OR* **Public**: One or more injuries, not severe.	**Workforce:** (1-4) Fatalities *OR* **Public**: One or more severe injuries including permanently disabling injuries.	**Workforce**: Multiple fatalities (5-50) *OR* **Public**: multiple fatalities (1-10)	**Workforce**: Multiple fatalities (>50) *OR* **Public**: multiple fatalities (>10)
Health (Adverse effects resulting from chronic chemical or physical exposures or exposure to biological agents)		**Workforce:** Minor illness or effect with limited or no impacts on ability to function and treatment is very limited or not necessary *AND* **Public:** No impact	**Workforce**: Mild to moderate illness or effect with some treatment and/or functional impairment but is medically managable *OR* **Public**: Illness or adverse effect with limited or no impacts on ability to function and medical treatment is limited or not necessary.	**Workforce**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management *OR* **Public**: Illness or adverse effects with mild to moderate functional impairment requring medical treatment.	**Workforce** (1-4): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management.	**Workforce** (5-50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** (1-10): Serious illness or chronic exposure resulting in fatality or significant life shortening effects.	**Workforce** (>50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** *(>10)*: Serious illness or chronic exposure resulting in fatality or significant life shortening effects.
Environment		Impacts such as localized or short term effects on habitat, species or environmental media.	Impacts such as localized, long term degradation of sensitive habitat or widespread, short-term impacts to habitat, species or environmental media	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media	Impacts such as significant, widespread and persistant changes in habitat, species or environmental media (e.g. widespread habitat degradation) .	Impacts such as persistant reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.	Loss of a significant portion of a valued species or loss of effective ecosystem function on a landscape scale.

The above legend applies only to HES risks, where risk levels 1-6 are actionable and mandatory.
For risks that may result in facility damage, business interruption, loss of product, the "Assets" category below should be used.
Asset risk reduction is at the discretion of management. Under no circumstances may a direct or indirect translation of Asset loss to HES consequences, or between any discrete categories of HES consequences be inferred.

Consequence Descriptions & Index (without safeguards)

Consequence Descriptions	Consequence Indices	6 Incidental	5 Minor	4 Moderate	3 Major	2 Severe	1 Catastrophic
Assets (Facility Damage, Business Interruption, Loss of Product)		Minimal damage. Negligible down time or asset loss. Costs < $100,000.	Some asset loss, damage and/or downtime. Costs $100,000 to $1 Million.	Serious asset loss, damage to facility and/or downtime. Costs of $1-10Million.	Major asset loss, damage to facility and/or downtime. Cost >$10 Million but <$100 Million.	Severe asset loss or damage to facility. Significant downtime, with appreciable economic impact. Cost >$100MM but <$1billion.	Total destruction or damage. Potential for permanent loss of production. Costs >$1billion

This matrix is endorsed for use across the Company.
It is not a substitute for, and does not override any relevant legal obligations.
Under no circumstances should any part of this matrix be changed or modified, adapted or customized.
This matrix identifies health, safety, environmental and asset risks and is to be used only by qualified and competent personnel.
Where applicable it is to be used within the Riskman2 structure and governance of an OE Risk Management Process. If applied outside of these Processes, it is also mandatory to manage identified intolerable risks and comply with the Risk Mitigation Closure Guidelines.

Appendix D Demonstration of ALARP for Stressors Requiring Further Risk Reduction

Three stressors were identified in Table 4-4 and Table 4-5 as having a Risk Priority Ranking of *Tolerable (if ALARP)* or *Tolerable (if ALARP and long-term risk reduction*) (i.e. below a Risk Ranking Level of 7). Further details are provided here on the justification for considering these risks have been reduced to ALARP.

Stressor	Demonstration of ALARP
Construction	
Artificial Light (Onshore)	Artificial light associated with remaining onshore and offshore construction activities was considered to be tolerable (if ALARP) (Table 4-4) for these key reasons: • at the time of the 2015 risk assessment, most construction activity had been completed, including almost all offshore construction • common lighting design principles (described in Section 5.1.1) have been implemented • additional lighting design features for the GTP and associated terrestrial infrastructure (described in Section 5.1.4.1) have been implemented • management measures (described in Table 5-3) have been implemented • monitoring of marine turtle population parameters before and during construction of the Gorgon Gas Development indicates that artificial lighting had no significant adverse impact on marine turtles (Ref. 13) • annual reviews of lighting effectiveness during the construction period concluded lighting design features, management measures, and operating controls were effective (Ref. 13). There are no reasonably practicable alternative methods or additional controls for lighting; total elimination of lighting would result in increased safety and operational hazards and increased potential for failing to comply with applicable legislation and standards.
Artificial Light (Offshore)	Artificial light associated with remaining onshore and offshore construction activities was considered to be tolerable (if ALARP) (Table 4-4) for these key reasons: • at the time of the 2015 risk review, most construction activity had been completed, including almost all offshore construction. • common lighting design principles (described in Section 5.1.1) have been implemented • marine vessel lighting design features (described in Section 5.2.2.1) have been implemented • management measures (described in Table 5-3) have been implemented • monitoring of marine turtle population parameters before and during construction of the Gorgon Gas Development indicates that artificial lighting had no significant adverse impact on marine turtles (Ref. 13) • annual reviews of lighting effectiveness during the construction period concluded lighting design features, management measures, and operating controls were effective. There are no reasonably practicable alternative methods or additional controls for lighting. Elimination of lighting would result in increased safety and operational hazards; increased potential for failing to comply with applicable marine/navigation legislation and standards; inability to identify waterborne hazards; and inability for vessels to participate in emergency response (e.g. search and rescue, spill response).
Physical Interaction (Offshore)	Physical interaction as a result of marine vessel strike during construction was considered to be tolerable (if ALARP) (Table 4-4) for these key reasons: • at the time of the 2015 risk review, almost all offshore construction activity had been completed; therefore, the number of marine vessels engaged in the remaining construction activities had reduced considerably since peak construction • vessel management measures (described in Table 5-3) have been implemented

Stressor	Demonstration of ALARP
	• incident records during construction show impacts to turtles from dredging and vessel movements (strike) were fewer than initially expected, particularly for dredging • monitoring of spatial behaviour of female Flatback Turtles using satellite telemetry during construction of the Gorgon Gas Development indicates that marine vessel and dredging activities had no adverse impact to internesting behaviour of Flatback Turtles (Ref. 13). There are no reasonably practicable alternatives to using vessels for construction of the Gorgon Gas Development. The additional control of restricting the speed of vessels outside the Port of Barrow Island limits is not practicable due to the large distances that must be covered during normal transit, support, and resupply activities. There are no additional controls required for dredging; using turtle deterrent devices has been found to be very effective in reducing the number of turtle deaths in dredging projects worldwide.
Operations	
Artificial Light (Onshore)	Artificial light associated with onshore operations was considered to be tolerable (if ALARP) (Table 4-5) for these key reasons: • lighting design features for the GTP, flares, and associated terrestrial infrastructure (described in Section 5.1) have been implemented • emergency lighting system was designed in accordance with Australian Standard AS 2993.1:2005 Emergency and Escape Lighting and Exit Signs for Buildings (Ref. 68) • routine flaring (other than flare pilots) is not permitted during normal operation. Design features to reduce light spill in the event of flaring include relocating the ground flare away from east coast marine turtle nesting beaches and shielding flares (Section 5.1.3) • management measures (described in Table 5-3) have been implemented. There are no reasonably practicable alternative methods for flaring design and lighting, due to: • requirement for the safe and reliable disposal of hydrocarbon vapour and liquids via non-routine flaring in the event of process upsets or emergencies • total elimination of lighting is not considered practicable as it would result in increased safety and operational hazards and increased potential for failing to comply with applicable legislation and standards (e.g. Dangerous Goods Safety [Storage and Handling of Non-explosives] Regulations 2007 [WA], Occupational Safety and Health Regulations 1996 [WA]).
Artificial Light (Offshore)	Artificial light associated with offshore operations was considered to be tolerable (if ALARP and long-term risk reduction) (Table 4-5) for these key reasons: • lighting design features for the MOF/LNG Jetty and vessels (described in Section 5.2) have been implemented • management measures (described in Table 5-3) have been implemented • additional studies to further understand the effects of offshore artificial light (including light from LNG ships and Condensate vessels) on in-water dispersal, survivorship, and predation of Flatback Turtle hatchlings as they disperse from east coast beaches of Barrow Island may be undertaken as part of the scope of studies (defined in Section 7.0) • although studies are not mitigation measures, outcomes may provide data to support a revision of the risk profile; diagnosis of Management Triggers (as defined in Section 8.0 of this Plan); or evaluation of further long-term risk reduction measures, if required. There are no reasonably practicable alternative methods or additional controls for lighting, due to: • Total elimination of lighting is not considered practicable, as it would result in increased safety and operational hazards; increased potential for failing to comply with applicable marine/navigation legislation and standards; inability for vessels to identify waterborne hazards and distinguish the MOF/LNG Jetty; and inability for

Stressor	Demonstration of ALARP
	vessels to participate in emergency response (e.g. search and rescue, spill response). • During LNG and condensate loading, minimum lighting levels are mandated by safety and security regulations (e.g. Australian Maritime Safety Authority Marine Orders, legislated under the *Navigation Act 2012* [Cth]). Lighting is also required to identify any process safety issues and any loss of containment during transfer operations. • The design of the MOF/LNG Jetty already keeps lighting levels to the minimum level for safe operations (e.g. no permanently 'on' lights).
Physical Presence (Offshore)	Physical presence of marine infrastructure was considered to be tolerable (if ALARP and long-term risk reduction) (Table 4-5) for these key reasons: • design features for the MOF/LNG Jetty (described in Section 5.2) have been implemented • management measures (described in Table 5-3) have been implemented • physical characteristics of beaches adjacent to the causeway and MOF are monitored through the CSMMP (Ref. 8). • monitoring (via the CSMMP, Ref. 8) has indicated changes in beach profile, which could have implications for Flatback Turtle nesting and incubation success due to changes in the quality or quantity of, or access to, nesting habitat. However, monitoring of the Flatback Turtle population during construction of the Gorgon Gas Development has indicated that no significant adverse impacts to marine turtles have occurred (Ref. 13) • studies of dispersing Flatback Turtle hatchlings show that they continue to disperse successfully offshore (Ref. 13) • additional studies to further understand the effects of physical presence on Flatback Turtle hatchlings may be undertaken as part of the scope of studies (defined in Section 7.0) • studies to assess the impact of changes to nesting habitat may also be initiated in response to an exceedance of the Marine Turtle Nesting Habitat Management Trigger (as defined in the CSMMP Supplement: Management Triggers [Ref.9]) • studies to investigate potential mitigation measures to prevent or remediate changes to nesting habitat may also be initiated prior to, or in response to, an exceedance of the Marine Turtle Nesting Habitat Management Trigger (as defined in the CSMMP Supplement: Management Triggers [Ref. 9]) or a Performance Standard (as defined in Section 9.0 of this Plan or those defined in the CSMMP [Ref. 8]). • although studies are not mitigation measures, outcomes may provide data to support a revision of the risk profile; diagnosis of Management Triggers (as defined in Section 8.0 of this Plan or those defined in the CSMMP Supplement: Management Triggers [Ref. 9]); or evaluation of further long-term risk reduction measures, if required. There are no reasonably practicable alternative methods or additional controls for the physical presence of marine infrastructure, due to: • the MOF/LNG Jetty are critical infrastructure required to transfer LNG and condensate from the GTP on Barrow Island onto LNG ships and Condensate vessels for export • the open structure of the LNG Jetty allows water circulation and movement of marine turtles • physical infrastructure is confined to that required to meet the needs of the Gorgon Gas Development and is confined within the Marine Disturbance Footprint, defined in the Coastal and Marine Baseline State and Environmental Impact Report (Ref. 28).

Appendix E Identification of Marine Matters of National Environmental Significance (NES) and their Habitat

Appendix F Compliance Reporting Table

Section No.	Action	Timing
1.3.3	CAPL will comply with its obligations under the North West Shelf Flatback Turtle Intervention Program as agreed between CAPL and the WA Minister for the Environment from time to time.	All Phases
1.5	Additional stakeholder consultation and updates to this Plan will be undertaken should analysis of baseline control charts (Appendix A) require amendment to the management triggers defined in Section 8.0. To this end, baseline control chart analysis, and an assessment of the need to amend the management triggers and this Plan, will be completed and submitted to the DotEE and DWER by 1 January 2019 (or another date as agreed by DotEE and DWER).	All Phases
5.3	Any proposed preventive mitigation action will be developed in consultation with the MTEP, and a proposal will be submitted to DWER and DotEE for approval.	All Phases
Table 5-3	Lighting inspections of worksites and vessels with a permanent presence in the Port of Barrow Island will be undertaken during the turtle season.	All phases
Table 5-3	Site-based personnel working on the Gorgon Gas Development will be made aware of marine turtle management at Barrow Island.	All phases
Table 5-3	Monitoring programs will be implemented as outlined in Section 6.0.	All phases
Table 5-3	Studies will be implemented as outlined in Section 7.0	All phases
Table 5-3	Appropriate emergency response will be implemented in the event of a loss of containment.	All phases
Table 5-3	Installation of new permanent lighting, or the maintenance or alteration of existing permanent lighting at onshore, MOF, and LNG Jetty facilities will be consistent with the common lighting design principles described in Section 5.1.1.	All phases
Table 5-3	Risk-based inspections of vessels will be undertaken before mobilisation to identify potential strategies to reduce artificial light spill from vessels.	Construction
Table 5-3	Procedures will be implemented to prevent loss of containment during the bulk transfer of hydrocarbons and chemicals to/from vessels.	All phases
Table 5-3	Vessel movements, including any imposed speed restrictions within the Port of Barrow Island, will be under the control of the Barrow Island Port Captain.	All phases
Table 5-3	If marine turtles are sighted near the path of a vessel, vessels will divert to avoid them (if safe to do so), or slow down to idling speed.	All phases
Table 5-3	Vessels (other than LNG ships and Condensate vessels) working at night within the Port of Barrow Island during turtle season will be required to reduce lighting to the minimum required for safe operations.	All phases
Table 5-3	Management of offshore seismic data acquisition will include: • maintaining marine fauna observers (MFOs) on seismic vessels during turtle season • using soft-start procedures to warn marine fauna (including marine turtles) before start of marine data recordings • where practicable, scheduling seismic activities outside turtle season • if seismic activities occur during turtle season, reducing lighting to the minimum required for safe operations.	All phases
Table 5-3	The Barrow Island Terminal Regulations require all LNG ships and Condensate vessels entering the Port of Barrow Island to make best endeavours to reduce light spill and direct overboard lighting to the	All phases

Section No.	Action	Timing
	absolute minimum levels required, while meeting their own and regulatory safety and security requirements.	
Table 5-3	If maintenance dredging occurs during turtle season, MFOs will be maintained on dredge vessels.	Operations
Table 5-3	If major repairs of the DomGas pipeline are required in the waters surrounding Barrow Island during turtle season, a risk assessment will be carried out to identify if potentially significant Project-related stressors to marine turtles are present. If significant stressors to marine turtles are identified, these offshore management measures will be considered, where practicable: • Vessel movements, including any imposed speed restrictions within the Port of Barrow Island, will be under the control of the Barrow Island Port Captain. • If marine turtles are sighted near the path of a vessel, vessels will divert to avoid them (if safe to do so), or slow down to idling speed. • Vessels (other than LNG ships and Condensate vessels) working at night within the Port of Barrow Island during turtle season will be required to reduce lighting to the minimum required for safe operations.	Operations
Table 5-3	Vehicle traffic on marine turtle nesting beaches will be prohibited unless authorised by CAPL for environmental surveillance, beach clean-up, or in response to an emergency.	All Phases
Table 5-3	Recreational access to turtle nesting beaches will be prohibited during peak periods of marine turtle nesting and hatching. The period of access restriction may vary seasonally subject to observations of actual peak nesting and hatching activity via the monitoring program outlined in Section 6.0 and/or advice from a subject matter expert with expertise in turtle ecology.	All Phases
Table 5-3	During turtle season, temporary onshore lighting will be kept to the minimum required for safe operations and, where practicable, will be downward-facing and directed solely onto the work area.	Operations
Table 5-3	Permanent onshore task lighting will be normally ‘off’ and will be manually switched ‘on’ to provide the necessary task lighting required when work is taking place.	Operations
6.0	The monitoring program will be implemented in a way that meets the objectives defined in Table 6-1 to Table 6-3, while retaining operational flexibility such that abnormal events (e.g. extreme weather events), including those beyond CAPL’s control, can be accommodated. If it is not possible to implement or complete one or more monitoring scopes or a component of a scope (e.g. cyclone, safety concerns), CAPL will take measures to ensure the objectives of the monitoring program continue to be met	All Phases
6.0	Historical monitoring programs and studies that have been concluded are summarised in Appendix B. Close-out reports for the following historical monitoring programs will be provided to DWER and DotEE by 1 January 2019 (or another date as agreed by DWER and DotEE): • Marine Turtle Track Census Program • Flatback Turtle Satellite Tracking Program • Beach Temperature Monitoring Program.	All Phases
7.0	If a Review (±2 statistical deviation) or Action (±3 statistical deviation) Management Trigger is exceeded and the cause is deemed Project-	All Phases

Section No.	Action	Timing
	attributable, CAPL will—in consultation with the MTEP—review the requirement to initiate additional studies, as listed in Table 7-1.	
8.0	Demographic data are compared against the Management Triggers annually. The aim of the initial response to activation of any management trigger is to determine whether the cause is Project-attributable. If deemed Project-attributable, CAPL will, in consultation with the MTEP, initiate the associated response actions defined in Figure 8-1 according to the level of trigger activated.	All Phases
Table 10-1	Harm or mortality to listed marine turtles attributable to the Gorgon Gas Development is to be reported to DotEE and DBCA within 24 hours of detection.	All Phases
Table 10-1	Significant impacts detected by the monitoring program on matters of NES relevant to this Plan are to be reported to DotEE within 48 hours of detection.	All Phases