Rio Tinto Alcan

Section 9

Non-Avian Migratory Species

9 Non-Avian Migratory

9.1 Introduction

9.1.1 General Structure of the Section

This section documents the results of the detailed profiling and impact assessment work undertaken for the five listed non-avian migratory species that were assessed in detail because they are known, likely or could possibly occur based on the results of the review of matters of NES and the assessment methodology documented in **Section 4.3**.

The species are:

- Estuarine Crocodile (*Crocodylus porosus*) – known to occur within areas of the proposed Port, Hey and Embley River Ferry/Barge terminals, and Dam C. Possibly occurs within areas of the proposed new spoil ground and Albatross Bay spoil ground;
- Dugong (*Dugong dugon*) – known to occur within areas of the proposed Port, and Hey and Embley River Ferry/Barge terminal. Possibly occurs within the areas of the proposed new spoil ground and Albatross Bay spoil ground;
- Australian Snubfin Dolphin (*Orcaella heinsohni*) – known to occur within proposed Port area and likely to occur within the Hey and Embley River Ferry/Barge terminal area. Possibly occurs within the areas of the proposed new spoil ground and Albatross Bay spoil ground;
- Indo-Pacific Humpback Dolphin (*Sousa chinensis*) – known to occur within proposed Port area and likely to occur within the Hey and Embley River Ferry/Barge terminal area. Possibly occurs within the areas of the proposed new spoil ground and Albatross Bay spoil ground; and,
- Bryde's Whale (*Balaenoptera edeni*) – possibly occurs within areas of the proposed Port, proposed new spoil ground, Albatross bay spoil ground. Unlikely to occur within the Hey and Embley River Ferry/Barge terminal area.

Assessment of listed threatened estuarine and marine fauna, including marine turtles (which are also listed as migratory) and elasmobranchs, is presented in **Section 7**.

Section 4.5 (MNES Impact Assessment and Mitigation Measures) of the Tailored EIS Guidelines is structured into two parts. Direction on the required data collection/profiling and impact assessment work required for each part is outlined as follows.

- Part A relates to potential impacts associated with the mine, Port and associated infrastructure and outlines the assessment requirements for three of the six controlling provisions (listed threatened species and communities, listed migratory species and Commonwealth marine areas) associated with these activities; and,
- Part B sets out the assessment requirements that are to be addressed in relation to the impacts of the Project that have not been addressed in Part A. It includes the requirements to:
  - assess impacts relating to Project-related shipping activities for all six controlling provisions; and,
  - assess the impacts of the mine, Port and associated infrastructure for the three controlling provisions not included in Part A (World Heritage properties, National Heritage places and the Great Barrier Reef Marine Park).

This section is designed to meet the requirements of both Part A and Part B of Section 4.5 of the Tailored EIS Guidelines relating to impacts on listed non-avian migratory species. Detailed data collection/profiling and impact assessment work was conducted in the vicinity of the mine, Port and associated infrastructure as that is where greater potential impacts to these species were determined

to be. This is because the development of the mine, Port and associated infrastructure would require physical construction and development activities that could temporarily or permanently displace species or impact habitat. The data collection/profiling information and impact assessment work for listed non-avian migratory species associated with shipping activities was undertaken at a broader level of detail commensurate with the lower likelihood of potential impacts associated with these activities (refer **Section 4.5.3**). This approach is consistent with the requirements of Section 4.5 of Part B of the Tailored EIS Guidelines, which requires the assessment related to shipping activities to be undertaken commensurate with the likelihood of potential impact to the matters of NES.

This section is structured to document the results of the assessment of listed non-avian migratory species and present the information in a logical progression. This section is structured as follows:

Section 9.2 provides an overview of the benthic habitat survey approach and results. Additional detail on survey methodology is provided in **Section 7.2**.

Section 9.3 relates to Estuarine Crocodiles, **Section 9.4** relates to Dugongs and **Section 9.5** related to cetaceans. Each of these sections includes the following subsections:

- **Subsection 1 – Species Profile** (**9.3.1**, **9.4.1**, and **9.5.1**)
  - describes the secondary source profiling work undertaken, regional preferences, distribution and populations, ecology and habitat and known threats for each species.
- **Subsection 2 – Survey and Results** (**9.3.2**, **9.4.2**, and **9.5.2**)
  - describes the specific survey efforts and the results that describe Project area habitat preferences and the presence / abundance of the species in the Project area.
- **Subsection 3 – Likelihood of Occurrence within the Project Area** (**9.3.3**, **9.4.3**, and **9.5.3**)
  - provides a summary of the preferred habitat and likelihood of occurrence of each species within the Project area.
- **Subsection 4 – Relevant Impacts** (**9.3.4**, **9.4.4**, and **9.5.4**)
  - describes the relevant direct impacts of the Project.
- **Subsection 5 – Avoidance, Mitigation, Enhancement Measures and Residual Effects** (**9.3.5**, **9.4.5**, and **9.5.5**)
  - describes the measures proposed to reduce the relevant impacts of the Project and the residual risk of impacts.
- **Subsection 6 – Offset Measures** (**9.3.6**, **9.4.6**, and **9.5.6**)
  - describes the measures proposed to offset any significant impacts of the Project, where required.

Cumulative and consequential impacts on these species are documented in **Section 18.3.4**. The cumulative and consequential impact assessment was undertaken at a higher/more strategic level of detail when compared to the Project-specific impact assessment because it is based on the potential activities that may or may not occur as a result of other Projects.

9.1.2 General Approach to Detailed Impact Assessment

The Tailored EIS Guidelines require detailed impact assessment for each non-avian migratory species identified as either known or likely to occur within the Project area. A conservative approach was taken and species that could possibly occur were also selected for more detailed assessment. **Section 4.3** describes how the likelihood of occurrence for each species was identified. This detailed impact assessment focussed on potential impacts on key habitat for each species associated with the construction and operational stages of the Project.

In general, the detailed impact assessment process focused on the following key steps for each species assessed:

1. determination of the potential impacts of the Project on species;
2. identification of avoidance, mitigation, and enhancement measures to avoid and / or mitigate potential adverse impacts; and,
3. determination of the significance of the residual impacts.

To document the results of the detailed impact assessment process, the various subsections have been structured to provide an overview of the potential construction and operational impacts on each species. No indirect impacts have been identified for non-avian migratory species. **Table 9-1** outlines the potential direct impacts on non-avian migratory species considered during the detailed impact assessment process. These direct impacts have been identified based on the assessment of the likelihood of impacts as discussed in **Section 4**, including potential impacts from Project-related shipping (refer **Section 4.5** and **Appendix 4-A**). Certain risks associated with Project-related shipping, such as the introduction of pest species, have not been included on the basis that the likelihood of impacts occurring from these events would be rare (refer **Section 4.5.3.14**), and therefore are not relevant impacts for the non-avian migratory species.

Table 9-1 Potential Direct Impacts on Non-Avian Migratory Species

Direct Impacts
Physical disturbance to benthic or intertidal habitats from dredging, reclamation or piling
Creation of turbidity plume
Deposition of dredged sediments on benthic habitat
Physical disturbance to habitats (Dam C)
Entrainment in dredge
Underwater acoustic impacts from pile driving and vessel movements
Marine oil spill
Vessel strike

The magnitude of relevant impacts has been considered with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c) for non-avian migratory species, and has been categorised as:

- None/negligible impact – unlikely to be any effect or consequence on the migratory species;
- Minor impact – a small area of potentially important habitat or a small number of individuals would be directly or indirectly affected in no more than a few discrete locations but an ecologically significant proportion of the population of a migratory species would not be affected;
- Moderate impact – a large area of potentially important habitat, or a small number of individuals would be directly or indirectly affected and impact would occur over numerous sites. An ecologically significant proportion of the population of a migratory species may experience some short to medium term effects; or,

- High impact – impact would occur over a relatively large area of potentially important habitat and lead to the loss of a large proportion of the local important habitat large number of individuals. An ecologically significant proportion of the population of a migratory species may experience long-term impacts.

High and moderate residual impacts are considered to be significant, and none/negligible and minor residual impacts are not considered to be significant.

The concepts of 'important habitat' and 'ecologically significant proportion' are key to determining whether a significant impact is likely. Important habitat for a migratory species as described in DEWHA (2009c) is:

a) habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
b) habitat that is of critical importance to the species at particular life-cycle stages;
c) habitat utilised by a migratory species which is at the limit of the species range; and/or,
d) habitat within an area where the species is declining.

The definition of an ecologically significant proportion of a population refers to whether the portion of a migratory species population potentially affected is especially important for the overall species population with respect to attributes such as genetic variability, contribution to reproductive effort or success, or particular site specific behavioural patterns that may be of significance for the overall population (DEWHA 2009c).

The extent to which areas utilised by migratory non-avian species within the Project area represent important habitat, and the potential for migratory non-avian populations within the Project area to comprise ecologically significant proportions of overall populations are addressed in the impact assessment sections for each species (refer **Section 9.3.4**, **9.4.4** and **9.5.4**).

9.2 Benthic and Shoreline Habitats

Environmental baseline data were collected to describe the existing physical and biological marine and estuarine environment in the Project area. The Project area is shown in **Figure 3-8** and includes:

- the proposed Port site;
- the proposed new spoil ground 17km offshore of Boyd Point;
- the existing Albatross Bay spoil ground;
- the temporary seaborne access;
- the barge and ferry terminals in the Embley and Hey Rivers; and,
- the Ward River and Norman Creek estuaries.

Potential habitats that may be utilised by Estuarine Crocodiles, Dugongs and cetaceans in the vicinity of the Project include the following:

- inshore and offshore reefs;
- seagrass;
- soft sediments;
- mangroves; and,
- estuarine habitat.

The survey methodologies and results for these habitats are detailed in **Section 7.2**.

9.3 Estuarine Crocodile

9.3.1 Species Profile

9.3.1.1 Regional Distribution and Population

The Estuarine Crocodile (*Crocodylus porosus*), also known as the Saltwater or Indo-Pacific Crocodile, is listed as migratory under the EPBC Act.

The species' range and population numbers are reduced worldwide, however in northern Australia it is widespread, occurring in coastal and sub-coastal areas between Maryborough in Queensland and Broome in Western Australia (Burbidge 1987, McNamara and Wyre 1993). The Estuarine Crocodile is commonly encountered in the Weipa area, including the freshwater swamps and creek systems within the Weipa mining leases (Dames and Moore 1996, Herbert 1995, Winter and Atherton 1985). The tributaries that collectively form the Port Musgrave (Wenlock River – Tent Pole Creek) system and the Albatross Bay system surrounding Weipa (including the Embley-Hey estuary adjacent to the Project area) have been identified as the two most significant Estuarine Crocodile habitats in Queensland (Taplin *et al.* 1988).

Populations of Estuarine Crocodiles in Australia are recovering from commercial hunting which drove them near to extinction in the 1970's (Leach *et al.* 2009). Population estimates for the Estuarine Crocodile in Australia range between 100,000 and 200,000 adults (Fukuda *et al.* 2007). Recently, their distribution in the Northern Territory has expanded into freshwater habitats and the numbers living in other marginal habitats, such as the coasts and seas, has increased (Leach *et al.* 2009).

In addition, The Species Group Report Card – Marine Reptiles: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012n), have not identified Estuarine Crocodiles as a conservation value of regional priority.

9.3.1.2 Life Cycle

Estuarine Crocodiles first reproduce at approximately 12 and 16 years of age for females and males, respectively. During the breeding season, males become more mobile as they look for a mate. Courtship begins in October/November (Webb *et al.* 1987).

The Estuarine Crocodile is a mound nester, preferring areas with tall vegetation and permanent water close by. Nesting occurs during the wet season between November and May with a peak in January and February. After mating, the female deposits between 40 and 70 oval-shaped eggs, approximately 8cm in length (Webb and Manolis 1989). The rotting vegetation incubates the eggs inside the mound. The temperature of the nest, which is determined by heat generated within the nest and the external ambient temperature, determines the sex of the hatchlings (Magnusson 1979a). The incubation period lasts approximately 90 days.

The adult female excavates the nest after hearing the calls of the hatchlings, and carries them to the water (Webb *et al.* 1987). Once in the water, hatchlings are stimulated by the calls of other hatchlings and form crèches, moving up to 9km during the first month in the water (Magnusson 1979b, Magnusson *el al.* 1980).

9.3.1.3 Ecology and Habitat

Estuarine Crocodiles mostly occur in tidal rivers, coastal floodplains and channels and swamps up to 150km inland from the coast (Webb *et al.* 1987). In Queensland, the species is usually restricted to coastal waterways and floodplain wetlands. Queensland populations may also be found hundreds of kilometres upstream, such as in the waterways located in the southern Gulf of Carpentaria (Read *et al.* 2004). They can tolerate salinities ranging from freshwater to full strength sea water, and have been recorded in water twice as saline (7.0%) as sea water.

Adult Estuarine Crocodiles are capable of extensive movements throughout the landscape. Although large-scale migratory movements are not a regular occurrence, individuals have been recorded moving over distances of several hundred kilometres. Localised migration associated with dispersal of individuals from breeding areas and movement to nesting and foraging habitats is also common (EPA 2007). Within the Project area, seasonal movements of individuals into freshwater habitats created by wet season rains and movement between proximal drainage systems have been observed and are likely to represent the predominant movements undertaken by the species in the area.

In addition to movement between drainage systems, regular wet season movement of sub-adult and adult individuals from estuary to freshwater stream reaches and wetlands occurs. Numerous observations have been made of individuals and slides well upstream on seasonal systems including the Ward River / Coconut Creek, Norman Creek, and Triluck / Winda Winda Creek. These movements may be undertaken to take advantage of the nesting and foraging habitats that become available within these freshwater habitats during the wet season (DSEWPaC 2012q).

The preferred nesting habitat for the Estuarine Crocodile includes elevated, isolated freshwater swamps that do not have the influence of tidal movements (Webb *et al.* 1987). Nests are often located on floating rafts of vegetation (Webb *et al.* 1987). In contrast to the Wenlock Basin, the area between Weipa and Aurukun within which the Project area occurs is not regarded as key breeding habitat for the species, although observations of nests and juvenile individuals confirm that the species does breed within the Project area at least in low densities (Magnusson *et al.* 1980).

The estuarine reaches of rivers within the Project area are not well suited to nesting due to the occurrence of dense fringing mangroves or the flooding of *Melaleuca* swamps from wet season stream flows. In contrast, the grassy woodland habitat adjacent to the reaches of freshwater systems located upstream provide flood-free nesting locations and access to deep water habitat for nesting females. Wet season freshwater habitats are also likely to provide seasonally available prey resources such as breeding fish aggregations, feral pigs and macropods that utilise freshwater stream resources. Some of the smaller seasonal stream systems within the Project area appear unlikely to support successful nesting and hatching of young, but support adult individuals, implying that seasonal movement of individuals between stream systems occurs within the Project area.

Estuarine Crocodiles between two and six years of age may travel up to 80km from their nest site. The movements of older animals are not well documented, however relocated animals have been documented to make long distance movements (up to 280km) (EPA 2007). Recent satellite tracking of Estuarine Crocodiles captured in the Wenlock Basin, adjacent to the Project area, confirmed individual movements within the Wenlock Basin and beyond, including movements to the Project area (University of Queensland 2012).

The Estuarine Crocodile is an opportunistic carnivore and is active throughout the year (Cooper and Jenkins 1993). Estuarine Crocodiles normally rest in the water or bask in the sun through much of the day. Hunting occurs at night, with individuals targeting all types of animals in the water or on dry land. Juveniles feed preferentially on smaller animals such as insects, crustaceans, small reptiles and fish. In Australia, large adults feed on kangaroos, dingos, goannas, birds, domestic livestock, pets, humans, water buffalo, bats, and even sharks (Webb and Manolis 1989).

9.3.1.4 Threats

Estuarine Crocodile eggs are subject to predation by goannas and feral pigs, however, egg predation is not a major source of egg mortality due to the presence of the guarding female. The main reasons for the failure of eggs to hatch include infertility, flooding, overheating, poor gas exchange, and desiccation. It is estimated that up to 75% of eggs laid in a season will not hatch (Australian Museum 2012).

Young Estuarine Crocodiles may fall prey to monitor lizards, predatory fish, various aquatic birds and raptors, larger Estuarine Crocodiles and other predators, with few making it to adulthood. As adults the only sources of mortality for Estuarine Crocodiles are from larger Estuarine Crocodiles and humans. Many Estuarine Crocodiles are killed accidentally in fishing nets (Taplin 1987, Webb and Manolis 1989).

It is estimated that less than 1% of eggs laid by Estuarine Crocodiles hatch and survive to adulthood. Threats to Estuarine Crocodiles, as cited in the SPRAT database (DSEWPaC 2012q) include, but are not limited to, the following:

- incidental catch of juveniles and adults in fishing gear or nets;
- habitat loss and degradation; and,
- habitat degradation by feral animals.

Pressure analysis conducted in The Species Group Report Card – Marine Reptiles: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012n), identifies no pressures "of concern" and only one pressure "of potential concern" for the Estuarine Crocodile (associated with potential Project-related impacts) which is invasive species – land-based activities. DSEWPaC (2012q) states the following about this pressure of potential concern.

> *"Invasive species are of potential concern for the saltwater crocodile. In Arnhem Land, feral animals such as buffalo can destroy wetland habitat by increasing drainage and reducing vegetation (Webb et al. 1984, 1987). Since the 1970s, disturbance of floodplain habitats by feral buffalo has been greatly reduced following eradication campaigns, with a resultant improvement in nesting habitat for crocodiles (Leach et al. 2009). However, more recently it has been reported that there are increasing numbers of buffalo and pig, which have the potential to negatively impact on nesting vegetation (Leach et al. 2009). There is also anecdotal evidence that saltwater crocodile habitat is affected by the invasion of freshwater wetlands by introduced plants such as Mimosa pigra, which can reduce the availability of nesting habitat (Leach et al. 2009). As a combined consequence of this invasive plant species and several feral animal pressures, crocodile habitat and available nesting areas may be reduced, thereby potentially impacting on the population."*

9.3.2 Estuarine Crocodile Survey Methodology and Results

9.3.2.1 Survey Methods

The *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPaC 2011d) does not include guidelines for the survey of Estuarine Crocodiles. EHP currently monitors the abundance and distribution of Estuarine Crocodiles in Queensland waterways using a standardised spotlight survey methodology. For the Project, data relating to the distribution and abundance of Estuarine Crocodiles was collected opportunistically. Surveys were undertaken throughout the Project area in 2007, 2008, 2009 and 2012, including where proposed Project activities would intersect potential Estuarine Crocodile habitat. These surveys provided detailed data relating to the distribution and abundance of Estuarine Crocodiles within the Project area.

Limited targeted surveys were also conducted in 2008 using spotlight survey techniques in the lower Ward River immediately downstream of the Project area boundary (**Figure 2-1**).

Foot transect surveys for fauna (including for Estuarine Crocodiles) in riparian and wetland habitats covered substantial sections of the upper Ward River/Coconut Creek, Norman Creek, Ina Creek and Winda Winda Creek systems. These surveys were undertaken over 27 days between May 2007 and May 2009, with potential habitat for the Estuarine Crocodile surveyed on each of these days. Transect methods included searches for individuals, slides, basking locations and nests. The focus of these surveys was to establish the extent of reproductive activity within the Project area by locating old nests. Most transects were undertaken during daylight hours.

To assess the potential impacts of Project activities on Estuarine Crocodile populations, a dedicated boat-based spotlight survey was undertaken over two nights in November and December 2008 in the lower Ward River, downstream of the Project area. Spotlighting was undertaken from a boat at 200m intervals along the stream channel, resulting in a total of 13km of river channel being surveyed. The first survey night covered the hours between sunset and midnight and the second covered from midnight to dawn.

Opportunistic observations of the Estuarine Crocodile and signs of the species (predominantly tracks and slides) were also made during aquatic biological surveys within the Project area at 28 sites during May 2008 and May 2009. Additional opportunistic sightings of individuals were made during collection of water quality samples throughout the Project area in 2008-2009 and during elasmobranch and cetacean surveys conducted in August 2012.

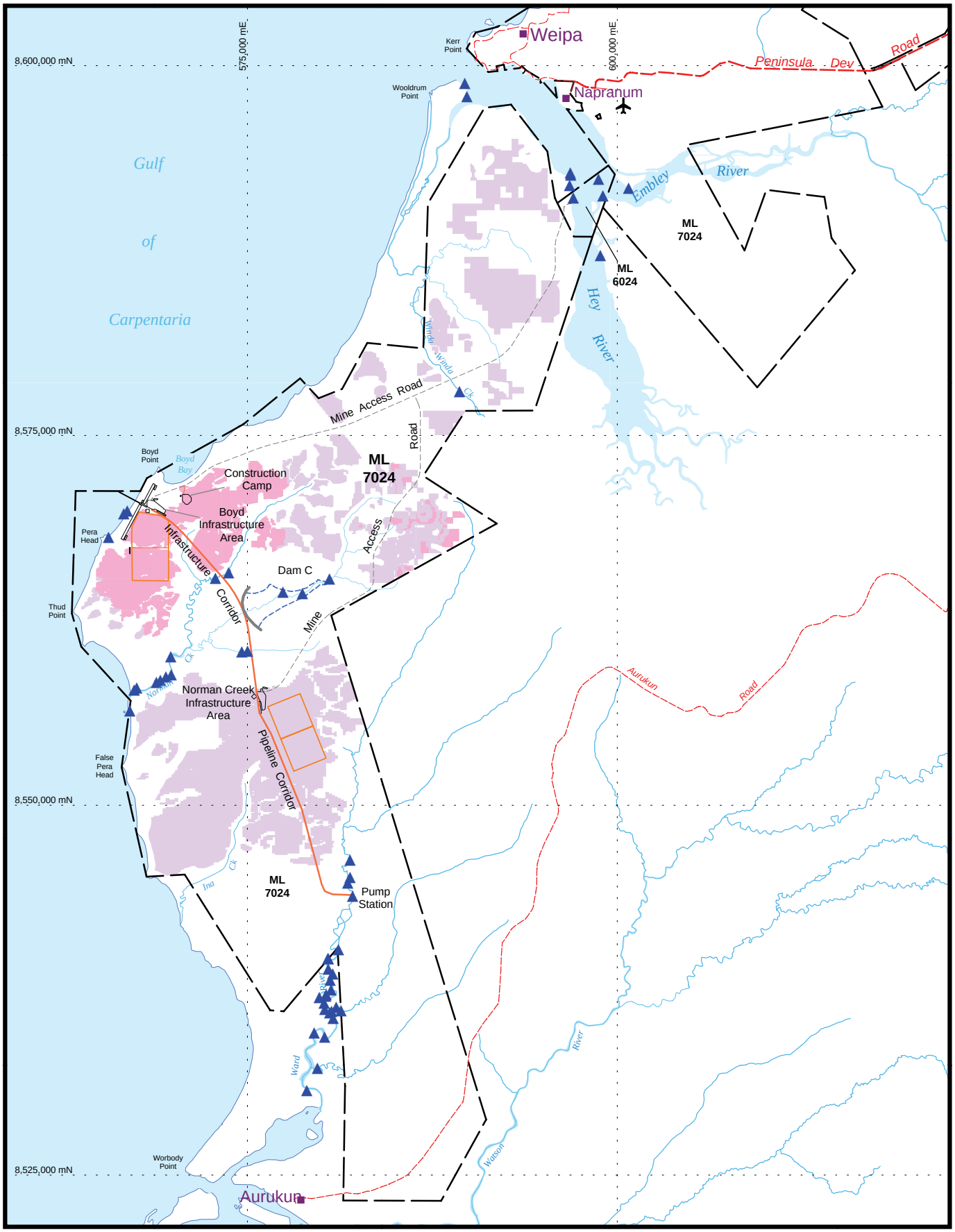
It is considered that these survey efforts were comprehensive and covered all potential important habitat for this species in the Project area, targeting nesting habitat as well as daylight and nocturnal observation of individuals.

9.3.2.2 Survey Results

The Estuarine Crocodile was recorded in all freshwater and marine habitats across the Project area, including freshwater swamps and inland streams, confirming the secondary source information reviewed (refer **Section 9.3.1.1**). Overall, the species is widespread and numerous within the Project area. Surveys recorded 55 individual sightings of the species within or downstream of the Project area (**Figure 9-1**). Surveys indicate that the species occupies the freshwater reaches of Norman Creek, Winda Winda Creek and the Ward River during the wet season. Habitat utilisation appears to change seasonally, with more use made of inland freshwater habitats during the wet season, including the middle and upper reaches of groundwater-fed tributaries of Norman Creek and Coconut Creek.

It appears that feral pigs represent a key feeding resource for the species within the freshwater habitats surveyed; especially groundwater-fed stream reaches along Norman Creek, Waterfall Creek and the Ward River – Coconut Creek systems.

Several nests and hatchling aggregations were located within the Project area on the middle reaches of Norman Creek and the lower reaches of the Ward River. An unused nest was located on the middle reaches of Winda Winda Creek. All these locations comprised a nest constructed of Blady Grass (*Imperata cylindrica*) within eucalypt fringing woodland and adjacent to an incised stream channel at least 2m deep. Each of these stream reaches would contain entirely freshwater during the breeding season with the nests located above the high flow level. It appears that these locations may be favoured for nesting over downstream paperbark wetlands due to the inundation of these latter areas by freshwater flows during the wet season.



RioTintoAlcan

- RTA Mining Lease boundary
- Locality
- Road/track
- Freshwater dam
- Tailings storage facility
- Mining Years 1 -13
- Mining Years 14 - 40

Estuarine Crocodile
(Crocodylus Porosus)

- EIS survey record

South of Embley Project

Fig. 9-1: Estuarine Crocodile Records

N

5 0 5km

Datum/Projection: GDA94/MGA Zone 54 Date: 01/11/2012

Preferential use of riparian areas upstream of the paperbark wetland zone for nesting was also identified by Traditional Owners (H. Kelinda pers. comm.). However, these nests may be more vulnerable to predation by feral pigs and wild dogs due to the exposed nature of these nesting areas.

Figure 9-2 depicts the potential movement patterns of individuals between stream systems within the Project area and the approximate extent of potential freshwater nesting habitat. Nests were located in the reaches of all three systems. Field surveys located several nests and hatchling aggregations within the Project area in Norman Creek, Winda Winda Creek and Ward River. In addition, one nest within the footprint of the proposed water supply dam (Dam C) was identified.

The REs associated with Estuarine Crocodile habitat in the Project area are REs 3.1.1a, 3.1.1c, 3.1.3, 3.1.5, 3.1.6, 3.3.9, 3.3.14a, 3.3.50a, 3.3.60a, 3.3.63, 3.3.64, 3.3.65, 3.5.22c (**Figure 4-1**). In contrast to the Wenlock Basin, the area between Weipa and Aurukun adjacent to the Project area was not previously regarded as key breeding habitat for the species (Magnusson *et al.* 1980). Although observations of nests and juveniles during the surveys confirm that the species does breed within the Project area, at least in low densities, the Project area would still not be considered key breeding habitat.

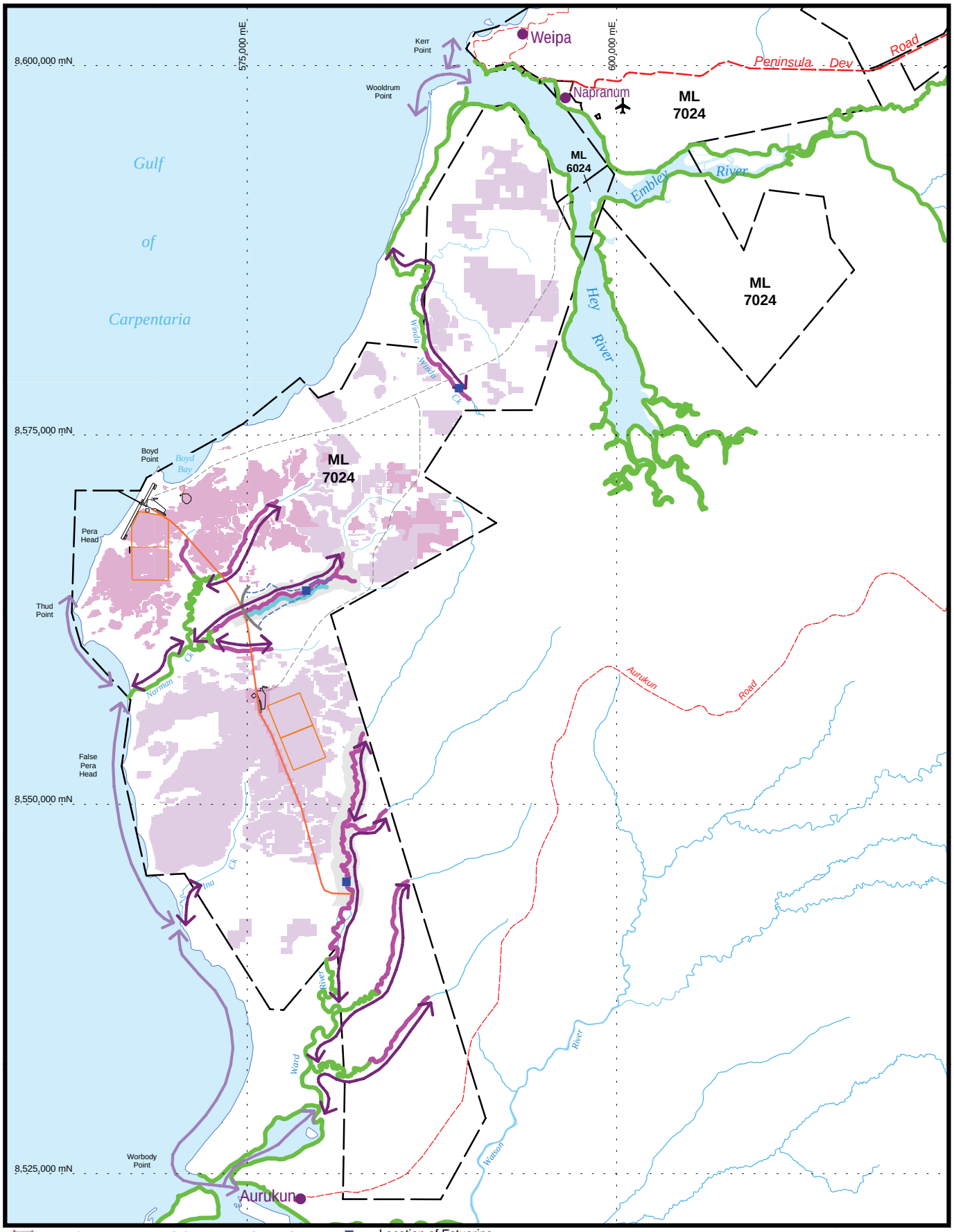
9.3.3 Likelihood of Occurrence within the Project Area

The likelihood of occurrence of Estuarine Crocodiles in the Project area and along Project-related shipping routes is presented in **Table 9-2**.

9.3.4 Relevant Impacts on Estuarine Crocodiles

Potential unmitigated impacts on the Estuarine Crocodile during the construction and operational stages of the Project may result from dredging and offshore spoil disposal, construction and operation of the marine and river facilities, and the operation of Dam C.

The following sections outline the potential unmitigated relevant direct impacts on Estuarine Crocodiles during the construction and operational stages of the Project. No indirect impacts on Estuarine Crocodiles related to the Project have been identified. **Table 9-3** provides a summary of the relevant impacts on Estuarine Crocodiles from Project construction and operational activities and provides cross references to the sections where they are described. The specific avoidance, mitigation and enhancement measures that would be implemented to reduce the potential impacts on Estuarine Crocodiles are presented in **Section 9.3.5**.



RTA Mining Lease boundary
Locality
Road/track
Freshwater dam
Tailings storage facility
Mining Years 1 -13
Mining Years 14 - 40
Surveyed for nests

Location of Estuarine Crocodile nest (2008/09)
Potential freshwater nesting habitat
Potential nesting habitat that would be disturbed by Dam C
Estuarine habitat
Seasonal and non-seasonal movements between drainage systems
Seasonal movements from estuary to freshwater wetlands and streams

South of Embley Project

Fig. 9-2: Estuarine Crocodile Habitat and Migratory Pathways

N

5 0 5km

Datum/Projection: GDA94/MGA Zone 54 Date: 06/09/2012

Table 9-2 Profile Summary - Estuarine Crocodile

Species	Habitat Preferences			Known / estimated population	Likelihood of Occurrence
	Foraging	**Nesting**	**Migratory**		
Estuarine Crocodile (*Crocodylus porosus*) (Migratory)	Tidal rivers, creeks, estuaries, coastal floodplains and channels, billabongs and swamps and freshwater areas. Seasonally available feeding resources exploited in wet season freshwater habitats.	The preferred nesting habitat for the Estuarine Crocodile includes elevated, isolated freshwater swamps that do not have the influence of tidal movements. Nests are often located on floating rafts of vegetation.	Adults are capable of extensive movements and known to move over several hundred kilometres, although large scale migratory movements are not thought to be a regular occurrence. Localised migration associated with dispersal of individuals from breeding areas and accessing nesting and foraging habitats is common. Regular wet season movement of sub-adult and adult individuals from estuary to freshwater stream reaches and wetlands occurs.	Approximately 1,800 for the North West Cape York Peninsula area, which encompasses the Project area.	**Proposed Port Site** **Known to Occur**: Recorded in marine environments within the Project area with individuals sighted along the beach between Pera Head and Boyd Bay. **Proposed New Spoil Ground** **Possible**: Recorded within marine environments within the Project area, although not as far out to sea as the proposed new spoil ground. However, this species is known to occasionally traverse some distance into the marine environment, so it is possible that this species may occur in this area on occasion. **Albatross Bay Spoil Ground** **Possible**: Recorded within marine environments within the Project area, although not as far out to sea as the Albatross Bay spoil ground. However, this species is known to occasionally traverse some distance into the marine environment, so it is possible that this species may occur in this area on occasion. **Ferry/Barge Terminals – Hey and Embley Rivers** **Known to Occur**: Recorded in estuarine environments within the Project area with individuals observed in close proximity to the proposed Hey Point and Hornibrook terminals. The ferry/barge terminal sites are within estuarine and sometimes mangrove environments that represent the main habitat for this species. The species is likely to use the habitat within the ferry/barge terminal areas for foraging and shelter. **Proposed Dam C - Norman Creek** **Known to Occur**: Foraging and nesting habitats for Estuarine Crocodiles have been recorded within the footprint of Dam C and upstream of Dam C. **Balance of Project Area not disturbed** **Known to Occur**: Field surveys recorded 55 individual sightings and numerous sightings of tracks and slides. **Shipping Routes** **Possible**: Estuarine Crocodiles may swim considerable distances offshore and so may potentially transit areas along the shipping routes. The likelihood of presence decreases further south towards Gladstone as this species is less common in these areas.

Table 9-3 Cross References to Impacts on Estuarine Crocodiles

	CONSTRUCTION ACTIVITIES			OPERATIONAL ACTIVITIES		
POTENTIAL IMPACT PRIOR TO MITIGATION	**Dredging and offshore spoil disposal**	**Marine and river facilities**	**Dam C**	**Dredging and offshore spoil disposal**	**Marine and river facilities**	**Dam C**
DIRECT IMPACTS						
Physical disturbance to benthic or intertidal habitats from dredging	**9.3.4.1**			**9.3.4.1**		
Physical disturbance to habitats from Dam C			**9.3.4.3**			**9.3.4.3**
Entrainment in dredge	**9.3.4.1**			**9.3.4.1**		
Underwater acoustic impacts from pile driving		**9.3.4.2**			**9.3.4.2**	

9.3.4.1 Dredging and Offshore Spoil Disposal

Capital dredging is required for the proposed Port, including berth pockets, swing basin and departure channel. Further minor dredging is required for the Hornibrook terminal, Humbug terminal and Hey River terminal. It is expected that the Port dredging would be carried out by a cutter suction dredge (CSD). Dredged material would either be pumped to several spilt hopper barges (SHB) or re-deposited on the sea bottom and retrieved by a trailing suction hopper dredge (TSHD). Dredging for the river facilities is anticipated to be undertaken using a barge-mounted backhoe/dipper dredge, with a bucket up to approximately 13m^3 or a small non propelled CSD pumping to a SHB (**Table 9-4**).

Dredge spoil would be disposed offshore at either the proposed new spoil ground offshore of Boyd Point (spoil from the Port) or at the existing Albatross Bay spoil ground (spoil from the river facilities). Dredging activities would be conducted 24 hours a day, seven days a week. At the Hey River, Humbug and Hornibrook terminals, dredging would be conducted for a maximum of 14 consecutive days with a pause of three days between dredging periods at each site.

Capital dredging and offshore spoil disposal activities are described in detail in **Section 3.8**. The total volume of capital dredging required for Stage 1 of the wharf is 6.5 million cubic metres, however, this would be completed in phases with no individual dredging campaign would exceed 2.6 million cubic metres.

Table 9-4 Summary of Capital Dredging Activities for the Project

Project Area	Dredging Volume (m^3)	Dredged Area(m^2)	Duration (weeks)	Dredging Method	Disposal Area
Port	Max 2,600,000 in any campaign	Initial capital dredge area: 800,000 Max. (Stage 2 wharf): 1,921,500	Max 24[1] in any campaign	CSD and SHB/TSHD	Proposed new spoil ground
Humbug Wharf	15,600	8,100	1 – 2	Barge-mounted backhoe/CSD and SHB/TSHD	Albatross Bay spoil ground
Hey River	37,380	25,000	2 – 4		
Hornibrook Point	57,600	23,300	3 – 5		

Subsequent capital and maintenance dredging would be undertaken as required under separate Sea Dumping Permits. The initial capital dredge volume for the proposed Port (2.6 million cubic metres) would require (on average) annual maintenance dredging of approximately 490,000m^3 to maintain under keel clearance for ships. Based on the maximum 6.5 million cubic metres of capital dredging for Stage 1 of the wharf, average annual maintenance dredging of approximately 890,000m^3 is expected to be required. Once the wharf is extended (Stage 2), an extra 2.4 million cubic metres of capital dredging and 280,000m^3 of average annual maintenance dredging would be required.

Material dredged during the maintenance programs would be disposed of at the proposed new spoil ground west of Boyd Point.

The chemical and physical characteristics of material that would be dredged from the proposed Port area and the barge/ferry terminals were assessed in accordance with *National Assessment Guidelines for Dredging 2009* (NAGD), Annex 2 of the London Protocol, and the Waste Specific Guidelines for Assessment of Dredged Material (IMO 2000b) (refer **Section 7.2.10** and **Appendix 7-B** for additional information). The assessment, including elutriate and bioavailability testing, indicated that all dredge spoil is suitable for unconfined ocean disposal, and testing did not identify any constituents present at contaminant levels of environmental concern that would persist in the water column during dredging or sea disposal. Future maintenance dredging would be completed under a separate Sea Dumping Permit and this would likely require further sediment sampling and testing to demonstrate that sediments are acceptable for sea dumping in accordance with the NAGD guidelines. Capital and maintenance dredging and offshore spoil disposal has the potential to impact on Estuarine Crocodiles and their habitat. The potential direct impacts include:

- physical disturbance to benthic or intertidal habitats from dredging; and,
- entrainment in dredge.

These potential direct impacts are discussed in detail below.

Physical disturbance to benthic or intertidal habitats from dredging

During capital dredging, benthic habitats in the dredge footprint of the Port and river facilities would be completely removed until such time as they recolonise (although re-colonisation may be limited by subsequent maintenance dredging during the operational phase of the Project). Benthic surveys have identified that the development footprint for the Port consists primarily of soft-sediment habitats that are unlikely to support significant numbers of the prey consumed by Estuarine Crocodiles.

[1] This estimate does not allow for any delays that may occur due to breakdowns or stand-downs which could result from cyclonic weather if dredging during the wet season.

The benthic habitats in the dredge footprint of the Port are not considered to be an important habitat for Estuarine Crocodiles.

The proposed dredging activities within the Hey and Embley Rivers would result in a negligible impact on the viability of the adjacent mangrove system, or to fisheries values or habitat essential to Estuarine Crocodile. The overall area of disturbance from dredging in the Hey and Embley Rivers would only be up to 3.3ha.

Based on the above assessment, it is anticipated that the potential unmitigated impact on Estuarine Crocodiles from the physical disturbance to benthic habitats associated with capital dredging would be negligible and short term.

Given the relatively minor scale of maintenance dredging activities in comparison to capital dredging, the low occurrence of suitable foraging habitat within the dredge area footprints, and the fact that the habitats would have been previously by disturbed, the potential unmitigated impact on Estuarine Crocodiles from the physical disturbance to benthic habitats from maintenance dredging would be negligible but would continue throughout the duration of the Project, so would be long term.

Entrainment in dredge

Dredging activities using a TSHD may injure or kill individual Estuarine Crocodiles as a result of accidental intake and entrainment as the trailing dredge head moves along the seabed. However, the high mobility and manoeuvrability of Estuarine Crocodiles means they are unlikely to be at risk of entrainment in dredging equipment, which would be slow moving. The use of fauna exclusion devices on the dredge heads would also minimise the potential for entrainment. Entrainment by CSDs is less likely due to the slow rate of area covered by dredging and barge-mounted backhoe/dipper dredger would not pose an entrainment hazard to Estuarine Crocodiles.

Based on the above assessment, it is anticipated that the potential unmitigated impact on Estuarine Crocodiles from entrainment in dredge would be negligible and would eventuate only during dredging campaigns, so would be short term.

9.3.4.2 Marine and River Facilities Construction and Operations

Construction of the Port facilities and the Humbug, Hornibrook and Hey River terminals are described in detail in **Sections 3.6.2**, **3.7.2** and **3.8**. The Port facilities would initially include the construction of an approach jetty, a wharf and two berths. Separate berths would be provided for tugs and pilot boats. The Port would be equipped with navigational aids.

Construction works for the Humbug terminal would include floating pontoons and ramps as well as mooring dolphins. An area of about 400m^2 may be reclaimed behind a sheet pile wall or alternatively a concrete abutment supported by piles would be constructed. Construction works for the combined Hornibrook terminal and tug berths would include piling for pontoon's for each facility and with a floating ramp common to both facilities. The Hey River terminal would include construction of floating pontoons and ramps. An area of approximately 4,400m^2 would be reclaimed and supported by rock revetment and/or sheet piles, or a concrete abutment may be constructed.

Temporary seaborne access, including a beach landing ramp for barges and small boats and a passenger jetty, may also be required during the construction phase of the Project (refer **Section 3.6.5**). The temporary seaborne access facilities would be removed when no longer required after permanent facilities have been constructed.

Underwater noise during construction would be principally generated by pile driving activities at the proposed Port, river facilities and temporary seaborne access. The numbers and positions of piles proposed for the Project are provided in **Section 3.6.2** and underwater noise associated with the Project is detailed in **Section 15.3** and **Appendix 15-A**.

Underwater noise is not identified as a potential impact on Estuarine Crocodiles (Leach *et al.* 2009) nor is it identified as a threat to the species in the DSEWPaC SPRAT database (DSEWPaC 2012q). Crocodiles are known to occur within the vicinity of the marine facilities within the Embley River, where similar construction and operational activities have been conducted. Similarly, the species would be expected to continuing utilising environments surrounding the Project marine facilities. Therefore, it is anticipated that the potential unmitigated impact on Estuarine Crocodiles from underwater noise associated with piling activities would be negligible and short term.

9.3.4.3 Dam C

A water supply dam (Dam C) would be constructed in a tributary of Norman Creek. It would have a storage capacity of up to 29GL and would have a footprint area of up to 700ha. The location and hydrological impact of Dam C is described in **Section 16.2.3**. The physical disturbance to habitats from Dam C has the potential to impact on Estuarine Crocodiles and their habitat.

Field surveys found one nest located within the proposed footprint of Dam C. This location would be inundated by the dam. The breeding season for Estuarine Crocodiles is during the wet season (typically between November and May) with peak nesting occurring in January and February (Webb and Manolis 1989). The potential freshwater nesting habitat of Estuarine Crocodiles totals 71.3km of stream reaches in Winda Winda Creek, Norman Creek, Ward River and their associated tributaries. Although estuarine habitats appear primarily unsuitable for nesting due to the abundance of mangroves and seasonal inundation of swamps, additional nesting habitat may be available on the stream levees in estuarine areas. The length of potential nesting habitat that would be disturbed by the proposed Dam C footprint comprises 6.7km of stream habitat, representing approximately 9% of the total available freshwater nesting habitat within the Project area. The area of disturbance would be a small fraction of the available nesting habitat in the Weipa Plateau Subregion (described in **Section 4.2.1.1**).

In contrast to the Wenlock Basin, the area between Weipa and Aurukun adjacent to the Project area was not previously regarded as key breeding habitat for the species (Magnusson *et al.* 1980). Although observations of nests and juveniles during the surveys, confirm that the species does breed within the Project area, at least in low densities, the Project area is still not be considered key breeding habitat.

It is unclear whether the Dam C would affect access of breeding females to potential freshwater habitat upstream and whether juveniles potentially hatched upstream of the Dam C would be exposed to increased mortality rates in traversing to lower reaches as stream flows recede in the dry season. The very minimal current breeding levels indicated in the Project area during EIS surveys and indicated in previous research (Magnusson *et al.* 1980) suggest that the abundance of Estuarine Crocodiles in Norman Creek is probably more dependent on migration of juveniles from other breeding locations rather than breeding within the Norman Creek system. An indication of coastal movement patterns is provided in **Figure 9-2**.

There is a possibility that the Dam C may provide a permanent aquatic habitat area that assists juvenile recruitment as impoundments such as Lake Argyle have been found to favour juvenile recruitment and development (Dr G Webb, pers. comm.).

The loss of nesting habitat in the Dam C reach and potential for elevated mortality of juveniles in the Dam C impoundment is anticipated to be a very minor element of the overall population dynamics of the area and is not expected to adversely affect the Estuarine Crocodile population in Norman Creek or the wider Project area. It is not anticipated that the total breeding effort within the Project area would be significantly affected. Based on the above assessment, the high availability of alternate nesting and foraging habitat throughout the Project area and that the migratory pathways of a significant proportion of the local population are unlikely to be affected, the potential unmitigated impact on Estuarine Crocodiles associated with the presence of Dam C would be negligible and long term.

9.3.5 Avoidance, Mitigation, Enhancement Measures and Residual Impacts

Disturbance to the most suitable Estuarine Crocodile habitats would be avoided or minimised through implementation of the following:

- the proposed SoE environmental buffer system would exceed the requirement of the Queensland Coordinator General's approval conditions and comprise a methodology for determining set-back distances for mining from sensitive vegetation, instead of from the banks of watercourses and wetlands. The sensitive vegetation that would be buffered by Darwin Stringybark woodland would comprise the following vegetation types: riparian, wetland, estuarine, vine forest and coastal vegetation on sand. RTA would work with Traditional Owners and the relevant WCCCC Sub-committee on establishment of environmental buffers as part of the CHEMP. The proposed SoE environmental buffer system would maintain a network of undisturbed habitats and would be enhanced through the proposed fire management program (refer **Section 6.3.4.2** for additional details) which would conserve fire sensitive flora and promote overall vegetation diversity and the feral pig control program (refer **Section 7.3.6.4** for additional details) which would reduce pig damage to riparian and wetland areas and nest predation. Additional detail on the proposed SoE environmental buffer system is included in **Section 9.3.6**;
- the general avoidance measures discussed in **Section 3.13** would further reduce impacts by siting facilities in areas with less sensitive habitat; and,
- one water supply option considered for the Project involved constructing a second dam on the Ward River. This option involved a greater total area of disturbance of Estuarine Crocodile habitat and was not the preferred approach of Traditional Owners. By not adopting this approach, additional disturbance to Estuarine Crocodile habitat has been avoided.

No significant impacts are anticipated on the Estuarine Crocodile and no species specific mitigation measures are proposed. However a range of mitigation measures that would be implemented to protect marine and estuarine fauna and habitats would also reduce the risk of impacts on Estuarine Crocodiles, as described in the following sections.

An environmental management plan outline for the Estuarine Crocodile that summarises these avoidance, mitigation and enhancement measures is provided in **Appendix 9-A**.

9.3.5.1 Dredging and Offshore Spoil Disposal

Draft DMPs for the proposed Port and river facilities have been prepared (refer **Appendix 7-C** and **Appendix 7-D** respectively). The draft DMPs propose mitigation and monitoring measures for dredging and offshore spoil disposal activities. The mitigation and monitoring measures that would be implemented will be in accordance with the final DMP's, which will be approved by DSEWPaC and EHP.

Physical disturbance to benthic or intertidal habitats from dredging

Negligible impacts on Estuarine Crocodiles are anticipated as a result of physical disturbance to benthic or intertidal habitats associated with dredging activities and therefore no specific mitigation is warranted. However, a summary of proposed mitigation measures as outlined in the draft DMP's is provided below (subject to further consultation with DSEWPaC and EHP), which would further reduce the impact on Estuarine Crocodiles:

- accurate positioning systems to ensure dredging and disposal occur in approved areas;
- dredging activities would be restricted to locations shown on the dredging plan(s); and,
- dredging activities would be conducted using equipment that is in survey and registered, and complies with the conditions of relevant approvals.

Entrainment in dredge

A summary of proposed mitigation measures as outlined in the draft DMP's is provided below (subject to further consultation with DSEWPaC and EHP), which would further reduce the impact on Estuarine Crocodiles from dredge entrainment:

- all persons engaged in conducting dredging activities including but not limited to employees and contract staff would be trained in procedures and practices necessary to:
  - comply with the conditions of the relevant regulatory approvals; and,
  - prevent environmental harm during normal operation and emergencies; or,
  - under the close supervision of a trained person.
- the TSHD would have dredge heads with depth control, and where appropriate, fitted with marine wildlife protection or fauna exclusion devices (e.g. turtle deflector, deflector plates, tickler chains on dredge heads prior to and during operation); and,
- during daylight hours, operators of specified vessels would have a trained Marine Fauna Observer on watch during dredging operations.

9.3.5.2 Marine and River Facilities Construction and Operations

Underwater acoustic impacts from pile driving

The following mitigation measures would be implemented to further reduce the unmitigated impacts on Estuarine Crocodiles related to underwater noise from pile driving: all equipment and machinery would be maintained in accordance with manufacturer's recommendations and excessive underwater noise would be investigated and remedied.

9.3.5.3 Dam C

One water supply option considered for the Project involved constructing a second dam on the Ward River. This option involved a greater total area of disturbance of Estuarine Crocodile habitat and was not the preferred approach of Traditional Owners (refer **Section 3.13**). By not adopting this approach, additional disturbance to Estuarine Crocodile habitat was avoided.

No significant unmitigated impacts are anticipated on the Estuarine Crocodile and no specific mitigation measures are proposed. It should be noted that habitat continuity around the Dam C impoundment would be provided by a minimum 200m environmental buffer from the full supply level of the impoundment.

9.3.5.4 Enhancements

The feral pig control program (refer **Section 7.3.6.4**) designed to enhance the breeding success of marine turtles in the area would have consequential positive effect on Estuarine Crocodiles, as it would reduce threats associated with nest predation and habitat destruction by feral pigs.

The vegetation in the SoE environmental buffers would also be enhanced by the implementation of a favourable fire regime under a fire management program, which will be developed in cooperation with Traditional Owners and the relevant WCCCC sub-committee (refer **Section 6.3.4.2**).

9.3.5.5 Summary of Impact Assessment on Estuarine Crocodiles

Table 9-5 summarises the potential impacts on Estuarine Crocodiles resulting from the Project considering proposed mitigation measures and in relation to the significant impact criteria for matters of NES (DEWHA 2009c).

Table 9-5 Impact Assessment Summary – Estuarine Crocodile

Will the proposed works...	**Estuarine Crocodile (*Crocodylus porosus*): Migratory**
... substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;	The Estuarine Crocodile which has been confirmed as present throughout the Project area and predominantly utilises estuarine and freshwater habitats that would be located within riparian areas (SoE environmental buffers) that would not be directly affected by mining and only minimally affected by infrastructure development (Dam C) and predicted Project-related shipping. The movement of vessels would not modify, destroy or isolate any areas of important habitat for Estuarine Crocodile. The vast majority of habitats utilised by this species would be unaffected by the Project and substantial modification of any important habitats present is not expected to occur.
... result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;	The Project is unlikely to lead to the introduction of any invasive fauna that could affect the Estuarine Crocodile either within the Project area or along the shipping routes. There would be no ballast water exchange in the GBRWHA, and all vessels would be fully compliant with Australian quarantine regulations.
... seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Habitat is predominantly estuarine and freshwater riparian areas, although Estuarine Crocodiles may make migrations into marine areas, and have been found at long distances offshore. Disruption to the life cycle, feeding or resting behaviour of this species is not anticipated as primary habitat is located within the SoE environmental buffers with minimal infrastructure development. None of the proposed infrastructure development or predicted Project-related shipping activities in the marine, estuarine or freshwater areas would limit the migration behaviour of this species.

9.3.5.6 National Recovery Plan and Threat Abatement Plans

There is currently no national recovery plan or relevant threat abatement plans for Estuarine Crocodiles.

9.3.6 Offsets

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012b), offsets are not required where the residual impact is not likely to be significant (when assessed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c)).

Section 9.3.4 and **Section 9.3.5** of this report documents the results of the impact assessment process and concludes that there would be only negligible impacts on Estuarine Crocodiles and therefore not significant as outlined in **Section 9.1.2**. As such, offsets relating to Estuarine Crocodiles are not required under the Commonwealth offsets policy.

9.4 Dugong

9.4.1 Species Profile

9.4.1.1 Regional Distribution and Population

The Dugong (*Dugong dugon*) is listed as migratory under the EPBC Act.

The Dugong is a seagrass-dependant marine mammal of high biodiversity value, which inhabits tropical and subtropical coastal waters. It is the sole member of the genus *Dugong*, and the only extant species of the Family Dugongidae (Husar 1978, UNEP 2002).

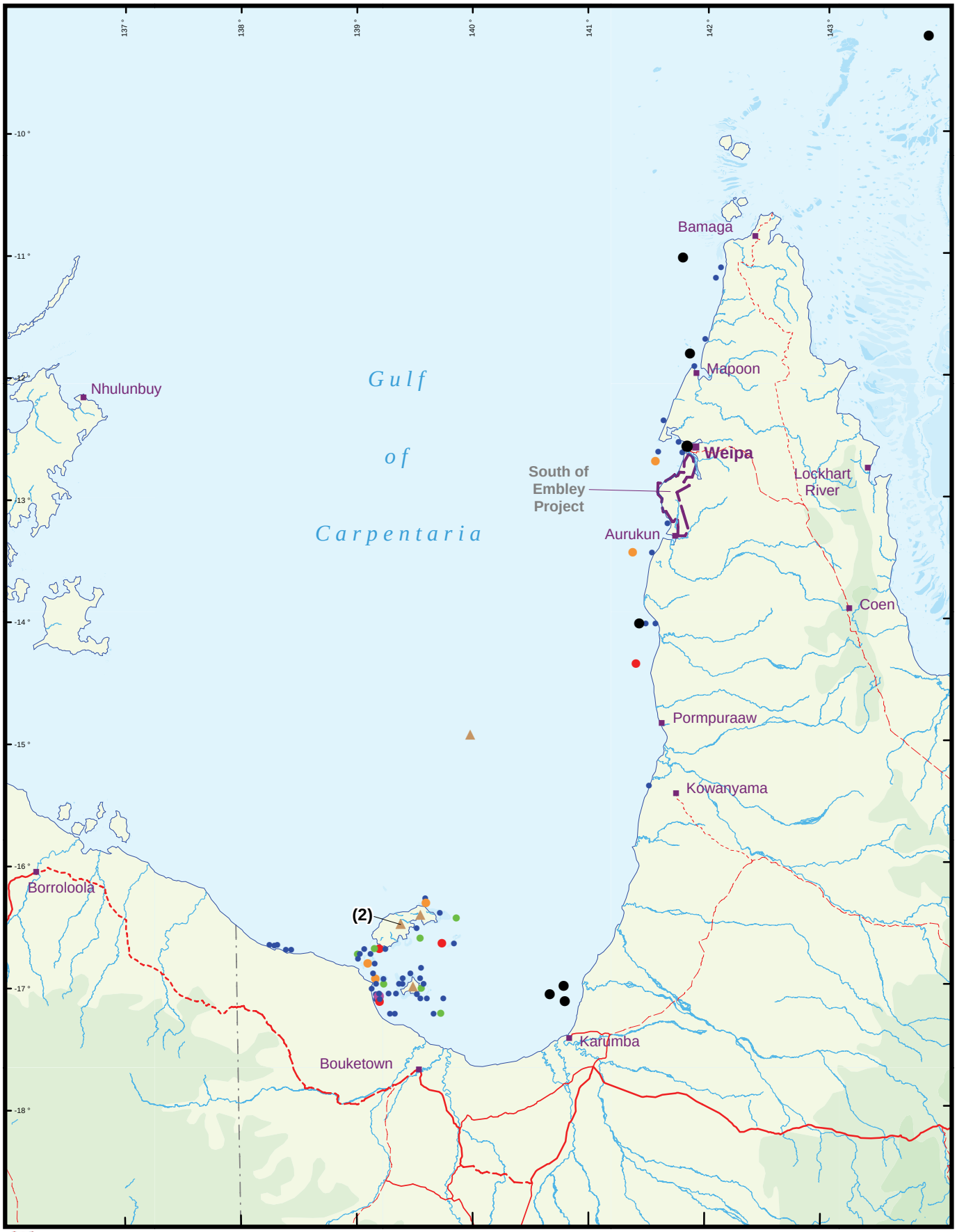
The Dugong's historic distribution has a large range that spans at least 37 countries and territories and includes tropical and subtropical coastal and inland waters from east Africa to Vanuatu to Japan. The Dugong is still present at the historical limits of its global range, although there is evidence of a reduction in the area of occupancy within its range. In most parts of its range, anecdotal evidence suggests that Dugong numbers are declining (UNEP 2002).

Most modern research on Dugong has been conducted in Australia. Aerial surveys carried out since the 1970's along much of the northern coastline of Australia, including the GBR and Torres Strait waters, have demonstrated that Dugongs occur between Shark Bay in Western Australia and Moreton Bay in Queensland (Lanyon 2003, Marsh 1988, Marsh and Lefebvre 1994). Approximately 85,000 of the world's Dugongs are found in the inshore waters of northern Australia and southern Papua New Guinea (Marsh and Lefebvre 1994). The Torres Strait region is considered the most important Dugong habitat in the world.

Dugongs are abundant at many locations in the Gulf of Carpentaria. Within the Gulf of Carpentaria, the Sir Edward Pellew Islands on the Northern Territory coast and the mouth of the Limmen Bight River are the most important areas in the Gulf of Carpentaria and represent the fourth most important site in Australia (Marsh *et al.* 2002). Of the estimated 27,602 (± 3,110) Dugongs in the Gulf of Carpentaria, only 15% occur in Queensland waters, reflecting the much greater area of seagrass present along the Northern Territory coast (Saalfield and Marsh 2004). Based on an estimated Australian population of 80,000, the Queensland Gulf of Carpentaria Dugong population represents approximately 5% of the Australian population. In 1997, Saalfeld and Marsh (2004) estimated the population of Dugong on the Queensland Gulf of Carpentaria coast to be 4,266 +/-657, which represented approximately 14-21% of the estimated Gulf of Carpentaria population at the time. Known records for the species within the eastern Gulf of Carpentaria are shown in **Figure 9-3**.

In a 1997 survey, seven Dugongs were sighted within the vicinity of the Project area; two within Albatross Bay, three adjacent to Albatross Bay, one near Aurukun; and one to the north of Jantz Point. At that time, it was estimated that these animals represented approximately 0.2% of the Queensland Gulf of Carpentaria coast population, between 0.023% and 0.035% of the Gulf of Carpentaria population, and 0.009% of the Australian population (Saalfeld and Marsh 2004).

Marsh (2008) surveyed the Dugong population within the Gulf of Carpentaria again in 2007, identifying one Dugong in the Weipa area. This was not sufficient to calculate a population size estimate for this area. Dugong distribution in the Weipa region, as with other areas, is associated with seagrass beds. However, as discussed above, the region is not recognised as supporting large numbers of Dugongs (**Figure 9-3**). The highest densities of Dugongs from the 2007 survey were located in the Wellesley Island area, approximately 450km south west of the Project area (Marsh 2008).



Project Boundary
Locality
River / Creek
Road / track

SOURCES: * Biddle *et al.* (2010), Greenland and Limpus (2006, 2008), Limpus *et al.* (1999)
Atlas of Living Australia (2012)
^ Saalfield and Marsh (2004)

NOTE: If number of records not indicated on map, then location is a single record

Dugong *(Dugong Dugon)*

- Stranding Mortality Database Record *
- Recorded Location#

Sightings ^
- 1
- 2
- 3
- 5
- Group of 200

(2) Number of records at location

South of Embley Project

Fig. 9-3:
Dugong Records
(eastern Gulf of Carpentaria)

N

0 150km

Datum/Projection: GDA94/MGA Zone 54 Date: 06/09/2012

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Grech *et al.* (2011) developed spatially explicit population models for Dugongs in northern Australia, including the Queensland Gulf of Carpentaria. Using aerial survey data collected in December 1991, December 1994, December 1997, November 2006 and November 2007, the relative density estimates, including mean densities and maximum densities were calculated. Based on these models, the Queensland Gulf of Carpentaria coastal waters had the second lowest mean (0.05 Dugongs/km^2) and maximum density estimates (1.92 Dugongs/km^2) in Northeast Australia. The Torres Strait and Hervey Bay had mean densities an order of magnitude higher (0.55 and 0.43 Dugong/km^2 respectively).

Dugongs generally do not appear to make seasonal large scale migrations; however, they are known to move over large distances. For example, a tracked Dugong in the Gulf of Carpentaria moved approximately 600km within a week (DSEWPaC 2012q). Marsh (2008) noted that there appears to be considerable movement of Dugong between the Wellesley Islands and the waters of northern Cape York (**Figure 9-4**), possibly due to episodic seagrass dieback.

9.4.1.2 Life Cycle

Dugongs have a low reproductive rate, long generation time, and a high investment in each offspring (Kwan 2002, Marsh 1995). Females do not bear their first calf until they are at least 10 or as late as 17 years old. They bear only one calf at a time, with pregnancy lasting between 13-15 months, and suckle the calf for approximately 18 months. On average, females produce calves only once every two to seven years (Marsh 1995, UNEP 2002). Calving intervals may lengthen as a result of food shortages. The Dugong's low reproductive rate means that a very high proportion (more than 95%) of adult animals have to survive each year for the Dugong population to be maintained. Thus the Dugong's biology makes it particularly vulnerable to rapidly increasing human pressures.

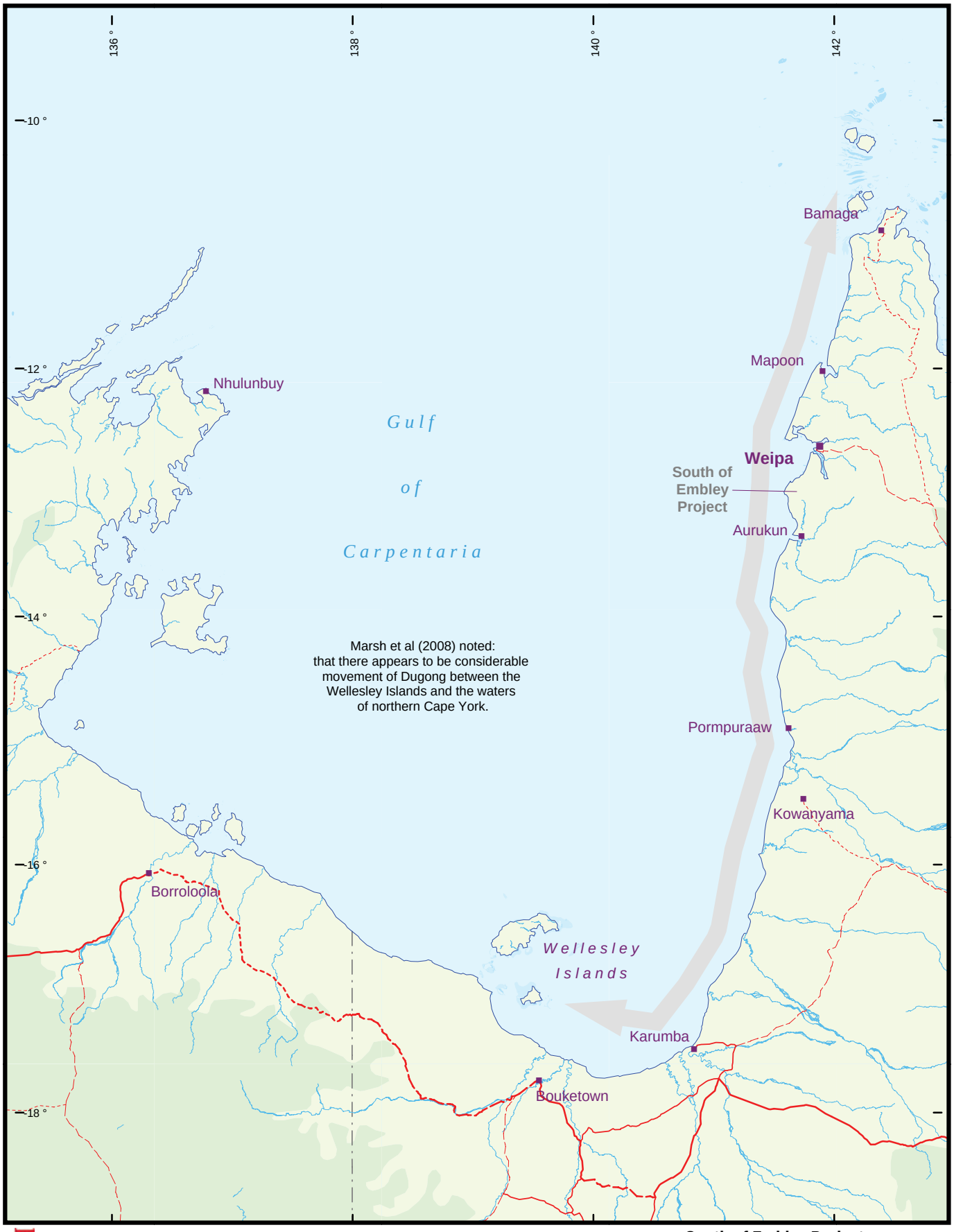
9.4.1.3 Ecology and Habitat

Dugongs are herbivorous marine mammals and feed only on seagrass. Dugongs consume the whole plant, including the roots if the plant can be uprooted. Dugongs prefer seagrasses that are pioneer species (Preen and Marsh 1995), especially species of the genera *Halophila* and *Halodule* (UNEP 2002).

The Dugong's habitat requirements and movements are still relatively unknown, and what is known is based largely on aerial survey observations. The highest densities of Dugongs are seen in water less than 5m deep in bays, shallows, island and reef areas that are protected against strong winds and heavy seas and which support extensive beds of seagrasses of the genera *Halophila* and *Halodule* (Bayliss 1986, Heinsohn *et al.* 1977, Preen 1995, Preen and Marsh 1995).

Dugongs are not confined only to inshore waters and have been documented utilising deepwater seagrass meadows. They have been seen up to 58km offshore in deeper waters between Cape Flattery and Cape Melville, estimated to be up to 37m deep (Marsh *et al.* 1986). More than 20% of the Dugongs sighted in Torres Strait have also been sighted in water 10 – 20m deep (Marsh and Saalfeld 1991, Lee Long *et al.* 1993, Marsh and Lefebvre 1994).

There is evidence that Dugongs use specialised habitats for various activities such as calving and mating. Shallow waters, such as on tidal sandbanks have been reported as sites for calving (Marsh *et al.* 1984) and it has been suggested that this may be a strategy to minimise the risk of shark predation (Anderson 1981, Marsh *et al.* 1984, UNEP 2002). Although there are some tidal sandbanks within the Project area there are no records of Dugong breeding in the area.



Locality

River / Creek

Road / track

South of Embley Project

Fig. 9-4: Notional Dugong Migration Pathway

N

0 150km

Datum/Projection: GDA94/MGA Zone 54 Date: 06/09/2012

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9.4.1.4 Threats

The incidental mortality of Dugongs in fishing gear is considered the most important direct threat to their populations on a global scale (Kiszka *et al.* 2008). Dugongs are accidentally drowned in commercial gillnets, particularly barramundi nets (Marsh 1988), and nets used to protect Queensland swimming beaches from sharks. Between 1962 and 1995, shark nets set on swimming beaches in Queensland netted 837 Dugongs (UNEP 2002).

Indirect threats to Dugongs in Australia include habitat loss and degradation. Trawling, dredging, inland and coastal clearing, land reclamation and boat propeller scarring may cause increases in sedimentation and turbidity, resulting in seagrass loss through smothering and lack of light. Other threats include sewage, detergents, heavy metals, hypersaline water from desalination plants and other waste products (DSEWPaC 2012q).

Threats to Dugong in the Gulf of Carpentaria, as cited in the SPRAT database (DSEWPaC 2012q) include, but are not limited to, the following:

- incidental catch in fishing gear or nets;
- habitat loss and degradation;
- Indigenous harvest; and,
- vessel strike and boating activities.

The Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) does not identify any pressures of concern and no Project-related pressures of potential concern for the Dugong.

9.4.2 Dugong Survey Methodology and Results

9.4.2.1 Survey Methods

There are no specific Australian survey guidelines for Dugongs. In order to determine population estimates and/or site specific habitat utilisation, more intensive surveys would be required over a significantly greater time scale than was available in this study. For example, the minimum length of time to detect patterns in Dugong populations is 9–10 years using annual surveys, however long-term trends can be established with 95% confidence with two surveys 10 years apart (Marsh 1989, 1995).

A comprehensive desk-top assessment of Dugongs in the Project area was undertaken and incidental observations for Dugongs were made during the various field investigations for the Project in 2007, 2008, 2009, 2010 and 2012. Incidental observations for Dugong were made during surveys for cetaceans which were conducted in August 2012 (coinciding with the netting survey for EPBC Act listed threatened sawfish and shark species). Nine days of observations were carried out, two days in the Boyd Point area, three in Norman Creek estuary and four days in the Hey and Embley estuary area. Six days of observations were carried out on board the dedicated dolphin spotting vessel at Boyd Point and in the Hey and Embley estuary and three days were conducted on board the netting vessel within the Norman Creek estuary.

This method, along with surveys of benthic habitats, was considered suitable to determine the likelihood of the presence of the species, to obtain qualitative data on habitat utilisation, and to determine the likely value of the habitat within the Project area.

9.4.2.2 Survey Results

Dugongs are known to occur in the Project area within estuarine and marine habitats; however no Dugongs were sighted in the Project area during any field investigations in 2007, 2008, 2009, 2010 or 2012. Field investigations verified the lack of seagrass beds and therefore suitable Dugong foraging habitat at the proposed Port site and the proposed new spoil ground (refer **Section 7.2.7**). Anecdotal records from Traditional Owners report that the species does migrate through Boyd Bay. It is also likely that Dugongs traverse through the proposed Port site as they move between foraging areas.

The long, strap-like seagrass, *Enhalus acoroides*, which dominates the seagrass beds of the Embley and Hey Rivers, is not considered to be a preferred seagrass species in the Dugong diet. No Dugongs were observed associating with these seagrass beds during Project field investigations.

Dugong feeding trails were observed in seagrass beds, comprising two seagrass species *Halophila ovalis* and *Halodule pinifolia*, in the lower Ward River estuary in December 2008. No feeding trails were observed in May 2009, suggesting that habitat utilisation by Dugongs may be greatest in the dry season when seagrass abundance, diversity and overall community extent would be expected to be more developed (refer Section 8.6.2 in Queensland EIS (RTA 2011)).

The absence of sightings of Dugong in the Project area supports the findings of Saalfeld and Marsh (2004) that populations in the vicinity of the Project area are likely to represent a low proportion (approximately 0.2%) of the Queensland Gulf of Carpentaria coast population (total 4,266 +/-657).

9.4.3 Likelihood of Occurrence within the Project Area

The likelihood of occurrence of Dugongs in the Project area and along Project-related shipping routes is presented in **Table 9-6**.

The potential habitat of Dugongs is presented in **Figure 9-5**.

9.4.4 Relevant Impacts on Dugongs

Potential unmitigated impacts on Dugongs during the construction and operational stages of the Project may result from dredging and offshore spoil disposal, construction and operation of the marine and river facilities, and Project-related shipping activities.

As discussed in **Section 9.4.1.4**, the Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) does not identify any pressures of concern and no Project-related pressures of potential concern for the Dugong. However, DSEWPaC (2102m) identifies the following Project-related pressures of less concern for the Dugong.

- physical habitat modification (potential Project-related impacts - dredging and/or dredge spoil disposal);
- changes in turbidity (potential Project-related impact - dredging);
- noise pollution (potential Project-related impacts - shipping and onshore and offshore construction); and,
- collision with vessels (potential Project-related impact - shipping).

The following sections outline the potential relevant direct impacts on Dugongs during the construction and operational stages of the Project. No indirect impacts on Dugongs related to the Project have been identified. **Table 9-7** provides a summary of the relevant impacts on Dugongs from Project construction and operational activities and provides cross references to the sections where they are described.

Table 9-6 Profile Summary – Dugong

Species	Habitat Preferences			Known / estimated population	Likelihood of Occurrence
	Foraging	**Breeding**	**Migratory**		
Dugong (*Dugong dugon*) (Migratory)	Seagrass beds typically dominated by *Halophila* and *Halodule* species. Seagrass beds that typically occur in shallow protected bays, shallow mangrove channels and the lee side of inshore islands.	Shallow waters, such as on tidal sandbanks and estuaries.	Generally do not appear to make systematic (seasonal) large scale migrations; but may move over large distances. Movement has been tracked up to approximately 600km and is thought to be associated with food availability.	Queensland coast of the Gulf of Carpentaria estimated population 7,000. The population of Dugong within the greater Gulf of Carpentaria area is considered one of the most important in Australia and the world.	**Proposed Port Site** **Known to Occur**: Traditional Owners report that the species migrates through Boyd Bay which also indicates migration past the proposed Port site. **Proposed New Spoil Ground** **Possible**: May migrate through this area between foraging grounds, although this site does not contain suitable foraging habitat. **Albatross Bay Spoil Ground** **Possible**: May possibly migrate through the area of the Albatross Bay spoil ground, although this site does not contain suitable foraging habitat. **Ferry/Barge Terminals – Hey and Embley Rivers** **Known to Occur**: Known to occur in the area, associated with seagrass beds. The seagrass beds in the Embley and Hey Rivers may potentially constitute foraging habitat for Dugong. **Balance of Project Area not disturbed** **Known to Occur**: Known to occur in the Project area. Traditional owners report that the species migrates through Boyd Bay. The species is highly mobile and would traverse coastal waters between seagrass beds. **Shipping Routes** **Likely**: Dugong may swim considerable distances offshore and so may potentially transit areas along the shipping routes. The likelihood of presence along the shipping route is greatest in Gladstone Harbour, which contains suitable habitat, and in shallower areas of the shipping route in Torres Strait.

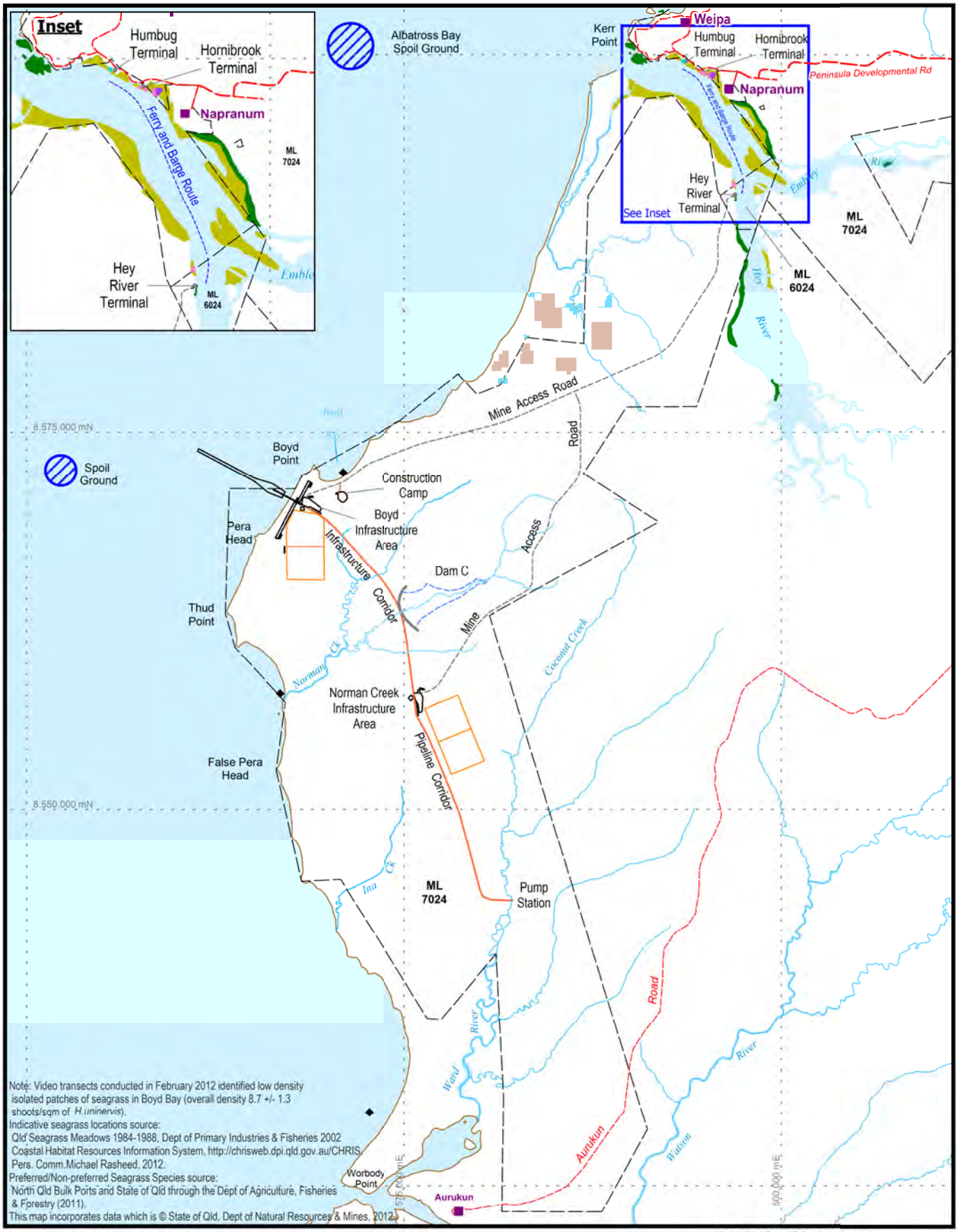

Inset
Humbug Terminal
Hornibrook Terminal
Napranum
Ferry and Barge Route
ML 7024
Hey River Terminal
ML 6024
Albatross Bay Spoil Ground
Kerr Point
Weipa
Peninsula Developmental Rd
See Inset
Spoil Ground
Boyd Point
Construction Camp
Boyd Infrastructure Area
Pera Head
Infrastructure Corridor
Access Road
Mine Access Road
Dam C
Thud Point
Mine
Norman Ck
Coconut Creek
Norman Creek Infrastructure Area
Pipeline Corridor
False Pera Head
8,575,000 mN
8,550,000 mN
Ina Ck
Pump Station
Ward River
Aurukun Road
Worboby Point
Aurukun
575,000 mE
600,000 mE
Note: Video transects conducted in February 2012 identified low density isolated patches of seagrass in Boyd Bay (overall density 8.7 +/- 1.3 shoots/sqm of H.uninervis).
Indicative seagrass locations source:
Qld Seagrass Meadows 1984-1988, Dept of Primary Industries & Fisheries 2002
Coastal Habitat Resources Information System, http://chrisweb.dpi.qld.gov.au/CHRIS.
Pers. Comm.Michael Rasheed, 2012.
Preferred/Non-preferred Seagrass Species source:
North Qld Bulk Ports and State of Qld through the Dept of Agriculture, Fisheries & Forestry (2011).
This map incorporates data which is © State of Qld, Dept of Natural Resources & Mines, 2012.
RTA Mining Lease boundary
Locality
Road/track
River
Freshwater dam
Tailings storage facility
Seagrass Survey February 2012
Seagrass (Halophila ovalis)
Seagrass (Enhalus acoroides)
Seagrass leaves (Enhalus acoroides), no rhizomes
Foraging Habitat
Preferred seagrass species
- Halodule uninervis (narrow)
- Halodule uninervis (narrow) with Enhalus acoroides
- Halodule uninervis (narrow) with mixed species
- Halophila ovalis with mixed species
Non-preferred seagrass species
- Enhalus acoroides
- Enhalus acoroides with mixed species
- Thalassia hemprichii
- Thalassia hemprichii with mixed species
Indicative seagrass locations
Rio Tinto Alcan
South of Embley Project
Fig 9-5:
Potential Habitat of Dugong
(Project Area)
N
5 0 5km
Datum/Projection: GDA94/MGA Zone 54
Date: 31/10/2012

Table 9-7 Cross References to Impacts on Dugongs

	CONSTRUCTION ACTIVITIES			OPERATIONAL ACTIVITIES		
POTENTIAL IMPACT PRIOR TO MITIGATIONS	**Dredging and offshore spoil disposal**	**Marine and river facilities**	**Shipping**	**Dredging and offshore spoil disposal**	**Marine and river facilities**	**Shipping**
DIRECT IMPACTS						
Physical disturbance to benthic or intertidal habitats from dredging and piling	**9.4.4.1**	**9.4.4.2**		**9.4.4.1**	**9.4.4.2**	
Creation of turbidity plume	**9.4.4.1**			**9.4.4.1**		
Deposition of dredged sediments on benthic habitat	**9.4.4.1**			**9.4.4.1**		
Entrainment in dredge	**9.4.4.1**			**9.4.4.1**		
Underwater acoustic impacts from pile driving and vessel movements		**9.4.4.2**	**9.4.4.3**		**9.4.4.2**	**9.4.4.3**
Marine oil spill			**9.4.4.3**			**9.4.4.3**
Vessel strike			**9.4.4.3**			**9.4.4.3**

9.4.4.1 Dredging and Offshore Spoil Disposal

A description of capital and maintenance dredging and offshore disposal activities is provided in **Section 9.3.4.1.** The potential direct impacts associated with dredging and offshore spoil disposal on Dugong include:

- physical disturbance to benthic or intertidal habitats from dredging;
- creation of turbidity plume;
- deposition of dredged sediments on benthic habitat; and,
- entrainment in dredge.

These potential impacts are discussed in detail below.

Physical disturbance to benthic or intertidal habitats from dredging

Physical disturbance of seagrass beds as a result of dredging activities has the potential to impact on Dugong foraging habitat. However, no seagrass beds were found, or are known to occur, within the dredge footprint of the proposed Port, temporary barge landing area or anchorages. Seagrass monitoring between 2000 and 2011 (Chartrand and Rasheed 2009, McKenna and Rasheed 2010, DAFF and NQBP 2011) in the vicinity of the Hey River terminal location has occasionally reported a very thin patch of isolated seagrass. However, drop camera surveys undertaken over the Hey River terminal dredge footprint in October 2007, November 2008 and June 2009 and grab samples in February 2012 did not record any seagrass. Nonetheless, it is possible that the seasonally variable seagrasses (e.g. *H. ovalis*) were absent at the time of these surveys. Overall, it is considered that if

any seagrasses do occur at the proposed Hey River terminal site from time to time, they are likely to contribute minimally to primary productivity in the area and are unlikely to be considered an important foraging habitat for Dugongs.

Low density (overall density of 8.7 ± 1.3 shoots/m^2), isolated patches of seagrass (*H. uninervis*) was found during the survey of the Boyd Bay option for the proposed temporary passenger jetty. A maximum direct disturbance area of 20m^2 due to the installation of piles for the temporary passenger jetty would occur in this area if this option is chosen. No seagrass beds were found in the proposed Humbug or Hornibrook terminal dredge footprint during the 2012 grab sampling survey (refer **Section 7.2.7**).

The total area of disturbance to potential foraging habitat by the proposed infrastructure, dredging and offshore disposal grounds has been calculated to be only 20m^2 for seagrass (as identified by drop camera surveys). The disturbance area represents less than 0.03% of the potential foraging habitat within the Project area and is negligible in terms of the potential habitat in which this species is likely to occur within the Project area.

While Dugongs may move through the Project area when periodically migrating between foraging areas, the disturbance of habitats from dredging activities would not represent a barrier to migration that is likely to result in any meaningful impact on Dugong populations in the region.

Based on the above assessment, no seagrass beds that constitute important foraging habitat for Dugongs would be disturbed as a result of dredging activities from the Project. Therefore it is anticipated that the potential unmitigated impact on Dugongs associated with capital dredging activities would be negligible and short term, but would continue throughout the duration of the Project for maintenance dredging, so would be negligible and long term.

As outlined in **Section 9.4.4**, The Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) identifies physical habitat modification as a pressure of less concern for the Dugong.

DSEWPaC (2012m) defines a pressure of less concern for a conservation value as either when:

1. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial; or,
2. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

This is consistent with the assessment that the impacts on Dugongs from physical disturbance to benthic or intertidal habitats associated with dredging would be negligible.

Creation of turbidity plume

As discussed in **Section 9.3.4.1**, all dredge material is suitable for unconfined ocean disposal and does not contain any constituents present at contaminant levels of environmental concern. The only change to water quality would result from suspended sediment in dredge plumes (refer **Appendix 7-A**).

A previous study (GHD 2005) has assessed the impacts of turbidity generated by dredging operations in the Port of Weipa. The study examined impacts from a dredging campaign involving a much larger volume (greater than 3,000,000m^3) of maintenance and capital material. It concluded that changes in water quality in sensitive areas, such as seagrass meadows to the north east of the existing Albatross Bay spoil ground, from migration of material would be negligible because plumes are predicted to migrate south towards the South Channel.

Current water quality monitoring results at the proposed Port, proposed new spoil ground, and the ferry and barge terminals all exhibit significant natural fluctuations in suspended sediment as reflected in the turbidity measurements. These areas experience naturally high turbidity and sedimentation rates over extended periods of time.

The disposal plumes at the proposed new spoil disposal ground have been predicted to disperse along a south south-easterly trajectory due to tidal currents and would not reach seagrass beds in the northeast (refer **Appendix 7-A**). The creation of turbidity plumes from dredging activities at the proposed Port area are predicted to disperse in a north-south direction along the coast and would not reach any seagrass meadows (refer **Appendix 7-A**) therefore would have a negligible impact on Dugong foraging habitat. Dredging activities for the river facilities would be of short duration (1-2 weeks), small volume and are predicted to have minor to negligible impact on seagrass beds within the Embley and Hey River.

Given the lack of contaminated material in the sediments that would be dredged, the predicted minor to negligible impact on Dugong foraging habitat, as well as the availability of alternate foraging habitat if necessary, it is anticipated that the potential unmitigated impact on Dugongs from turbidity plumes related to capital and maintenance dredging activities and offshore spoil disposal would be negligible and would only eventuate during dredging campaigns, so would be short term.

As outlined in **Section 9.4.4**, The Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) identifies changes in turbidity as a pressure of less concern for the Dugong.

DSEWPaC (2012m) defines a pressure of less concern for a conservation value as either when:

1. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial; or,
2. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

This is consistent with the assessment that the impacts on Dugongs from the creation of a turbidity plume associated with dredging would be negligible.

Deposition of dredged sediments on benthic habitat

Disposal of dredge spoil during capital and maintenance dredging may directly smother benthic habitat such as seagrass beds during disposal or subsequent migration with ocean currents. Although Dugongs are known to occur in low densities in Project area (Saalfield and Marsh 2004), the proposed new spoil ground and Albatross Bay spoil ground are both characterised as flat, unvegetated soft sediments habitat, and are therefore unlikely to represent suitable foraging habitat to Dugongs. In addition, the Albatross Bay spoil ground has been used for disposal of dredge sediments since 1998 (GHD 2005).

Based on the above assessment, the potential unmitigated impact on Dugongs from the deposition of dredged sediment on benthic habitats associated with capital dredging activities and offshore spoil disposal would be negligible and short term, but would continue throughout the duration of the Project for maintenance dredging, so would be negligible and long term.

Entrainment in dredge

As discussed in **Section 9.3.4.1**, dredging activities using a TSHD may injure or kill individual Dugongs as a result of accidental intake and entrainment as the trailing dredge head moves along the seabed. The use of fauna exclusion devices on the TSHD dredge heads would minimise the potential for entrainment of Dugongs. Entrainment by CSDs is less likely due to the slow rate of area covered by dredging and barge-mounted backhoe/dipper dredges would not pose an entrainment hazard to Dugongs.

Based on the above assessment, important foraging habitat for Dugongs is not present within the proposed dredge footprints, minimising the risk that Dugongs would be in the path of the dredge. However, in the event of entrainment, serious injury or mortality of an individual would be likely. The potential unmitigated impact on Dugongs from entrainment due to dredging activities would be minor and would only eventuate during dredging campaigns, so would be short term.

9.4.4.2 Marine and River Facilities Construction and Operations

Construction of the Port facilities and the Humbug, Hornibrook and Hey River terminals are described in detail in **Sections 3.6.2**, **3.7.2** and **3.8**. The Port facilities would initially include the construction of an approach jetty, a wharf and two berths. Separate berths would be provided for tugs and pilot boats. The Port would be equipped with navigational aids.

Construction works for the Humbug terminal would include floating pontoons and ramps as well as mooring dolphins. An area of about 400m^2 may be reclaimed behind a sheet pile wall or alternatively a concrete abutment supported by piles would be constructed. Construction works for the combined Hornibrook terminal and tug berths would include piling for pontoon's for each facility and with a floating ramp common to both facilities. The Hey River terminal would include construction of floating pontoons and ramps. An area of approximately 4,400m^2 would be reclaimed and supported by rock revetment and/or sheet piles, or a concrete abutment may be constructed.

Temporary seaborne access, including a beach landing ramp for barges and small boats and a passenger jetty, may also be required during the construction phase of the Project (refer **Section 3.6.5**). The temporary seaborne access facilities would be removed when no longer required after permanent facilities have been constructed.

Construction activities associated with the marine and river facilities have the potential to impact on Dugongs and their habitat. The potential impacts include:

- physical disturbance to benthic or intertidal habitats from piling; and,
- underwater acoustic impacts from pile driving.

These potential impacts are discussed in detail below.

Physical disturbance to benthic or intertidal habitats from piling

Physical disturbance of seagrass beds as a result of piling activities has the potential to impact on Dugong foraging habitat.

As discussed in **Section 9.4.4.1**, no seagrass beds were found, or are known to occur, within the footprint of the proposed Port, temporary barge landing area or anchorages and no seagrass beds were found in the proposed Humbug or Hornibrook terminal footprint during the 2012 grab sampling survey. Seagrasses that may occur at the proposed Hey River terminal site from time to time are likely to contribute minimally to primary productivity of the area and are unlikely to be an important foraging habitat for Dugongs (refer **Section 7.2.7**). Low density (overall density of 8.7 ± 1.3 shoots/m^2), isolated patches of seagrass (*H. uninervis*) were found during the survey of the Boyd Bay

option for the proposed temporary passenger jetty. A maximum direct disturbance area of 20m^2 due to the installation of piles for the temporary passenger jetty would occur in this area if this option is chosen. As such, no seagrass beds that constitute important foraging habitat for Dugongs are likely to be disturbed as a result of piling activities associated with the Project. The temporary seaborne access facilities would also be removed when no longer required after permanent facilities have been constructed.

While Dugongs may move through the Project area when periodically migrating between foraging areas, the disturbance of habitats from piling activities and introduction of artificial substrata would not represent a barrier to migration that is likely to result in any meaningful impact on Dugong populations in the region.

Based on the above assessment, it is anticipated that the potential unmitigated impact on Dugongs from the physical disturbance to benthic or intertidal habitats from piling activities would be negligible and short term and from the introduction of artificial infrastructure would be negligible and long term.

Underwater acoustic impacts from pile driving

Underwater noise during construction would be principally generated by pile driving activities at both the proposed Port and river facilities. Piling would be undertaken 24 hours a day. Underwater noise associated with the Project is discussed in detail in **Section 15.3.2** and **Appendix 15-A**.

Construction of the Port facilities and the Humbug, Hornibrook and Hey River terminals are described in detail in **Sections 3.6.2**, **3.7.2** and **3.8**.

Construction works for the Humbug terminal would include floating pontoons and ramps as well as mooring dolphins. An area of about 400m^2 may be reclaimed behind a sheet pile wall or alternatively a concrete abutment supported by piles would be constructed. Construction works for the combined Hornibrook terminal and tug berths would include piling for pontoon's for each facility and with a floating ramp common to both facilities. The Hey River terminal would include construction of floating pontoons and ramps. An area of approximately 4,400m^2 would be reclaimed and supported by rock revetment and/or sheet piles, or a concrete abutment may be constructed.

Temporary seaborne access, including a beach landing ramp for barges and small boats and a passenger jetty, may also be required during the construction phase of the Project (refer **Section 3.6.5**). The temporary seaborne access facilities would be removed when no longer required after permanent facilities have been constructed.

Dugongs are potentially sensitive to underwater noise, and high levels of underwater noise have the potential to temporarily drive Dugongs from the area, cause physical damage to their auditory system, or cause temporary changes in behavioural patterns. Underwater noise criteria have not been developed specifically for Dugongs to manage potential behaviour disturbance or injury. However, previous anatomical studies of Dugongs suggest that their overall hearing sensitivity would likely to be less than that of dolphins. Therefore, adopting the same underwater noise criteria for Dugongs as for dolphins would provide a conservative management basis (refer **Appendix 15-A**).

Modelling of underwater noise from pile driving activities (detailed in **Section 15.3.2.3**) concluded that noise emissions from the Project piling activities may cause injury to Dugongs only within the immediate vicinity of the piling rig. Potential distances of ecologically meaningful behaviour disturbance for Dugongs are presented below for the largest piles (pipe piles) at each facility (**Table 15–2**). Potential distances of ecologically meaningful behaviour disturbance from smaller piles would be less and are presented in the tables indicated below for each facility. The potential distance of ecologically meaningful behaviour disturbance would be 400m from the proposed Port for the

1,500mm piles (see **Table 15–6**), 380m from the Hey River terminal for the 1,050mm pile (see **Table 15–9**), 280m for the 1,050mm piles at the navigation aids to be installed in the Embley and Hey Rivers (see **Table 15–10**), 250m from the Hornibrook terminal for the 1,050mm piles (see **Table 15–8**) and 170m from the Humbug terminal for the 900mm piles (see **Table 15–7**). Dugongs may be disturbed up to 500m at the Port for a scenario where three piling rigs are operating simultaneously (one 1,500mm and two 1,050mm piling rigs) (see **Table 15–6**). This is the largest potential impact if three piling rigs are utilised, however impacts would likely be less if three rigs were operating on a different combination of piles or less than three rigs were operating simultaneously.

Potential distances of ecologically meaningful behaviour disturbance associated with vibratory piling (sheet piles) activities (Humbug and Hey River) terminals and drilling activities (Humbug, Hornibrook and Hey River terminals) were predicted to be less than 10m at all terminals (see **Table 15–6** to **Table 15–10**). Vibratory piling would also be used at the temporary seaborne access facilities near Pera Head and Boyd Point/Boyd Bay. Potential behaviour disturbance distances from these facilities were not modelled. However, the lower impact of this method compared to piling driving and the limited duration of acoustic impact in the vicinity of these facilities, given the small number of piles that would be installed at each facility (eight at the temporary barge landing and between 16 and 32 at the temporary passenger jetty), would mitigate the potential impact on Dugong in this area.

No seagrass beds are known to occur within the footprint of the proposed Port or temporary barge landing area at Pera Head. No seagrass was detected within the proposed Hornibrook and Humbug terminal footprints during 2012 surveys, however seagrass was found in nearby areas. No seagrass was detected within, or adjacent to, the proposed Hey River terminal dredging footprint during surveys. Samples collected in the bay to the north of the terminal, in an area previously known to have seagrass, recorded seagrass (*E. acoroides*) leaves (no attached rhizomes). Seagrass was confirmed as present at Boyd Bay within the likely distance of behaviour disturbance of the temporary jetty option in Boyd Bay.

While Dugongs may move through the Project area when periodically migrating between foraging areas, underwater noise from piling activities would not represent a barrier to migration that is likely to result in any meaningful impact on Dugong populations in the region.

Based on the above assessment, Dugongs in the vicinity of piling activities may be temporarily displaced, however, no seagrass beds within the Project area constitute important foraging habitat for Dugongs and alternate foraging habitat is available outside of the estimated impact distances. Therefore, the potential unmitigated impact on Dugongs from underwater noise associated with piling activities would be negligible and short term.

As outlined in **Section 9.4.4**, The Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) identifies noise pollution as a pressure of less concern for the Dugong.

DSEWPaC (2012m) defines a pressure of less concern for a conservation value as either when:

1. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial; or,
2. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

This is consistent with the assessment that the impacts on Dugongs from underwater acoustic impacts from pile driving would be negligible.

9.4.4.3 Project-related Shipping

It is noted that DSEWPaC's *Significant Impact Guidelines* (DEWHA 2009c) states that, where appropriate precautions have been taken against translocating potential pest species (refer **Section 4.5.3.14** for information relating to measures for mitigating risks associated with pest introductions from shipping), routine ship transits would not normally be expected to have a significant impact on a matter of NES. However an assessment of Project-related shipping activities on Dugongs has been made in accordance with the Tailored EIS Guidelines.

Project-related shipping activities have the potential to impact on Dugongs and their habitat. The potential direct impacts include:

- underwater acoustic impacts from vessel movement;
- marine oil spill; and,
- vessel strike.

Underwater acoustic impacts from vessel movement

Project-related shipping activities are discussed in **Section 4.5**. Underwater noise from shipping principally originates from propeller action and cavitation, movement of the water across the hull, and the transmission of on-board machinery noise as vibration through the hull of the vessel (IMO 2009, Southall 2005). A detailed discussion of underwater noise generation from Project-related shipping activities is provided in **Section 15.3.2**. In general, underwater noise from small to mid-size vessels (recreational vessels up to barges and workboats) is in the range of 165 – 180 180dB re 1µPa, and for large vessels such as bulk carriers is 180 – 190dB re 1µPa (OSPAR 2009).

Minimal data are available relating to the sensitivity of Dugongs to shipping noise. Dugongs are reported to produce relatively low-level underwater vocalisations, producing sounds quantified by Anderson and Barclay (1995) within the range of 3kHz to 18kHz for chirp-squeaks and between 500Hz and 2.2kHz for barks. The predominant sound frequencies associated with large vessels are in the range of 10Hz to 1kHz (OSPAR 2009), with main sound energy less than 200Hz (CEDA 2011). It is considered that Dugongs are unlikely to experience injury or hearing loss from noise associated with Project-related shipping activities but may show behavioural responses and avoid the Project area and shipping routes.

The predicted increase in Project-related shipping through the CMA is minor and the shipping movements through the Gulf of Carpentaria would remain at relatively low levels (refer **Section 10.3.5**). There is only a small predicted increase in Project-related shipping through the GBR compared to existing levels (refer **Section 11.3.4**). It is anticipated that Project-related shipping would not significantly alter the behavioural response of Dugongs or represent a barrier to migration that is likely to result in any meaningful impact on Dugong populations in the region.

Given the availability of alternate foraging habitats in the area and that Project-related shipping activities are unlikely to represent a barrier to migration; the potential unmitigated impact of underwater noise on Dugongs from Project-related shipping activities during construction would be negligible and short term and during operations would be negligible and long term as the impact would be present for the duration of the Project.

As outlined in **Section 9.4.4**, The Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) identifies noise pollution as a pressure of less concern for the Dugong.

DSEWPaC (2012m) defines a pressure of less concern for a conservation value as either when:

1. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial; or,
2. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

This is consistent with the assessment that the underwater noise impacts on Dugongs from vessel movements would be negligible.

Marine oil spill

The threat and likelihood of impacts from marine oil spills associated with Project-related shipping activities, including the results of stochastic oil spill modelling, are discussed in **Sections 4.5.3.4** and **4.5.3.5**. The impact of marine oil spills in the CMA and GBRMP are also assessed in **Sections 10.4.6** and **11.4.6**.

Marine oil spills have the potential to significantly impact on Dugongs if they are directly exposed or habitat is degraded. Dugongs may be directly harmed by surface oil and hydrocarbon vapours when they surface to breath. In Australia, the greatest risk of oil spills, in terms of both frequency and costs, relates to minor incidents occurring in ports via fuel and oil transfer spills (for spills exceeding 1t in volume) (DNV 2011). However, collisions of Project vessels with other vessels, stationary objects such as port structures and grounding on benthic substrates have the potential to cause marine oil spills of a greater volume as a result of damage to fuel tanks in the vessel's hull (refer **Section 4.5.3.3**).

Total predicted bauxite shipping (600 movements per annum at maximum production) equates to approximately 4.0% of long term shipping forecast in the inner GBR Designated Shipping Area. The predicted additional bauxite shipping at maximum production would represent approximately 0.4% of the GBRMPA (2012b) long term shipping forecast in the inner GBR for 2020. However, in 40 years of bauxite shipping from the Port of Weipa to the Port of Gladstone, there has been no reported collision or grounding incidents that have resulted in environmental harm. Project-related shipping (including the small increase at maximum production) is therefore not likely to increase the risk of collision or grounding and therefore a marine oil spill.

Stochastic spill modelling results outlined in **Appendix 4-D** suggested that, if a 25.25m^3 spill occurred, there would be up to 2% and up to 6% possibility of 0.01mm or thicker water-surface slicks entering the GBRMP from a spill at Fisherman's Landing and South Trees Wharf respectively if such a spill occurred. For the modelled cells within the GBRMP that have a possibility for oil on water, there is a maximum probability of 2% and 6% for a slick to occur from a spill at Fisherman's Landing and South Trees Wharf respectively. The model results for a five tonne spill at both Fisherman's Landing and South Trees Wharf would not result in any water-surface oil slicks of 0.01mm or thicker being transported into the GBRMP. Based on the DNV (2011) estimate of the annual probability of a spill (>10 tonnes) in the GBRMP being 0.0511, the probability of an oil spill greater than 10 tonnes from a Project-related vessel (bauxite or cargo) traversing the GBR is 0.0174 (1.74%) and the increase in the annual probability of a spill due to the predicted increase in Project-related shipping is estimated to be 0.0058 (or 0.58%). Given a similar increase in spill probability in the Port of Gladstone, the small potential increase in Project-related shipping at maximum production would only increase the risk of an oil or fuel spill entering the GBRMP to a negligible extent. It should be noted the modelling is based on a spill without any control measures. When operating in Australia, the Project-related bauxite ships would only take on bunker fuel at Gladstone, working under the existing controls and procedures of the Gladstone Ports Corporation (GPC). There would be no bunkering of bulk carriers at proposed

Port. The constraints on vessel speeds in the proposed Port and construction areas as well as the Port of Gladstone and the management initiatives that have been implemented along the shipping routes such as recommended pilotage regimes, means that the risk of a marine oil spill occurring due to collision or grounding is considered to be unlikely. The deeper water through the majority of the shipping routes also makes grounding of vessels unlikely. While the probability of a marine oil spill occurring is unlikely, such an incident would result in serious injury or mortality to Dugongs in the vicinity of the spill. Therefore, the potential unmitigated impact of a marine oil spill from Project-related shipping activities on Dugongs would be minor and short term.

Vessel strike

Project-related shipping activities are discussed in **Section 4.5.3.13** and the impact of vessel strikes on marine fauna in the CMA and GBRMP are assessed in detail in **Sections 10.4.3** and **11.4.2**.

Dugongs migrating through the Project area and shipping routes may be vulnerable to collision with Project-related vessels. There is current scientific evidence suggesting that death and injury caused by vessel strikes has a significant impact on Dugong populations in Queensland (Grech and Marsh 2008). The QPWS stranding database recorded ten Dugongs being struck in the GBR, or found within the area with vessel strike injuries between 1996 and 2010. This equates to a frequency of 0.66 Dugong vessel strikes per annum during this period in the GBR (a larger area than the GBRMP). Based on the proportion of Dugong deaths from vessel strike in Queensland reported to QPWS, the average mortality in Western Cape waters from vessel strike was calculated at 0.04 per annum over the period 1999 to 2010.

A recent study has found that the reaction time of Dugongs does not change in accordance with the speed of an approaching vessel and therefore faster moving vessels have a greater probability of causing Dugong mortality (Hodgson and Marsh 2007). Vessel strikes generally occur when there is a large number of fast, small vessels (e.g. less than six metres long) operating in shallow water where avoidance behaviour by Dugongs is effectively reduced. Speed appears to be a key issue affecting the frequency of incidents. For example, Laist *et al.* (2001) determined that 89% of vessel strikes on marine fauna examined involved vessels travelling in excess of 14 knots.

The Project involves operating a ferry between the Hornibrook and Hey River terminals and a barge between the Humbug terminal and the Hey River terminal. The operation of the ferry and barge may increase the risk of vessel strike on Dugong that may be present in the Embley/Hey estuary. Transit lanes would be defined to reduce the overall area of disturbance from vessel activities and the vessels would slow in shallower water as they approach berth. Transit lanes would also follow the greatest water depths to further avoid significant meadows of seagrass beds (refer **Figure 4-3** to **Figure 4-7**) unless directed otherwise by the Regional Harbour Master. As such, the Hey/Embley River are 2.5 to 3.5km wide and the nearest defined seagrass bed to the transit lane would be approximately 500m.

During construction, barges would transport materials from Cairns to the Port of Weipa and then to the Project area. Slow moving displacement vessels such as barges and tugs would be mostly operating in deeper water and are considered to pose a lower risk of vessel strike.

In the operational phase of the Project, bulk carriers such as those used for bauxite transport would be used. Bulk carriers are large and slow moving (14 knots being the usual cruising speed) and would be travelling more slowly and under pilotage in shallow or confined marine areas where Dugongs are more commonly found. Bauxite has been shipped from the Port of Weipa to the Port of Gladstone via the inner GBR Designated Shipping Area for over 40 years, and there have been no reported incidents of vessel strike on marine fauna by these vessels. Based on the predicted increase in vessel movements in the Project area and historic reported rates of vessel strike in the Western Gulf of

Carpentaria (QPWS Wildlife stranding database annual reports), it is estimated that mortality of Dugong as a result of vessel strike could increase by less than one per annum. Although it is noted that not all vessel strikes are reported, this estimated increase does not take into account that the majority of the potential increased vessel numbers pose a lower risk of vessel strike due to their size and speed. Therefore, Project-related bauxite shipping (including the small predicted increase at maximum production) is not considered to significantly increase the risk of vessel strike on Dugongs.

While the probability of vessel strike involving Project vessels is unlikely, such an incident may result in serious injury or mortality of an individual. Based on the above assessment, the potential unmitigated impact on Dugongs from vessel strike associated with construction shipping activities would be negligible and short term, and from operational shipping would be negligible and long term as the risk would be present for the duration of the Project.

The workforce involved in the construction phase of the Project would predominantly be accommodated at a construction camp within the Project area. As the construction workforce would be bussed to and from the construction camp at the beginning and end of each roster, their recreational time outside of the camp would be limited. It is anticipated that there would be a relatively small increase in the overall population of Weipa during the operational phase of the Project; however, this is unlikely to result in a significant increase in recreational vessels in the Project area. Therefore based on the above assessment, it is considered that the potential unmitigated impact of vessel strike from recreational vessels on Dugongs would be negligible and short term for the construction phase and negligible and long term for the operational phase of the Project.

As outlined in **Section 9.4.4**, The Species Group Report Card – Dugong: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012m) identifies collision with vessels as a pressure of less concern for the Dugong.

DSEWPaC (2012m) defines a pressure of less concern for a conservation value as either when:

1. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial; or,
2. there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

This is consistent with the assessment that the impacts on Dugongs from vessel vessel strike would be negligible.

9.4.5 Avoidance, Mitigation, Enhancement Measures and Residual Impacts

The following sections outline the specific avoidance, mitigation and enhancement measures that would be implemented to reduce the potential impacts on Dugongs associated with dredging activities and offshore spoil disposal, construction and operation of marine and river facilities, and Project-related shipping activities (described in **Section 9.4.4**).

An environmental management plan outline for the Dugong that summarises these avoidance, mitigation and enhancement measures is provided in **Appendix 9-A**.

9.4.5.1 Dredging and Offshore Spoil Disposal

Draft DMP's for the proposed Port and river facilities have been prepared (refer **Appendix 7-C** and **Appendix 7-D** respectively). The draft DMP's propose mitigation and monitoring measures for dredging and offshore spoil disposal activities. The mitigation and monitoring measures that would be implemented will be in accordance with the final DMP's, which will be approved by DSEWPaC and EHP.

Physical disturbance to benthic or intertidal habitats from dredging

Negligible impacts on Dugongs are anticipated as a result of physical disturbance to benthic or intertidal habitats associated with dredging activities and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on Dugongs from physical disturbances to benthic or intertidal habitats associated with dredging activities are the same as those detailed in **Section 9.3.5.1** for Estuarine Crocodiles.

Creation of turbidity plume

A summary of proposed mitigation measures as outlined in the draft DMP's is provided below (subject to further consultation with DSEWPaC and EHP), which would further reduce the impact on Dugong related to the creation of turbidity plumes from dredging activities and offshore spoil disposal:

- mechanical devices, such as turbidity-reducing valves within overflow pipes on the TSHD, would be used;
- hopper doors would be kept in good condition to minimise loss of sediment during transport;
- the TSHD would be equipped with below keel discharge of tail waters via an anti-turbidity control valve;
- accurate positioning systems would be used on dredges to ensure direct impacts are restricted to the approved dredging and disposal areas;
- direct sailing routes to and from the relevant spoil disposal ground would be selected to minimise the impact of propeller wash; water quality monitoring and trigger levels, as well as coral health monitoring (if required - refer **Appendix 7-C** for details) for dredging activities at the Port;
- current and forecasted meteorological and oceanographic information would be considered in the daily work plan; and,
- adaptive management measures would be implemented as required depending on the level of impact and may include:
  - moving the dredge operations and vessels to other areas within the development footprint to reduce potential impacts on the affected corals;
  - reducing or ceasing overflow during periods when the dredge plume is considered likely to lead to further impacts; or,
  - reducing dredging activities from 24 hours a day to a period timed to reduce impacts (e.g. to 12 hours/day or night).

With the implementation of these mitigation measures, residual impacts on Dugong from the creation of a turbidity plume associated with dredging activities and offshore spoil disposal would be minor, and would eventuate only during dredging campaigns so would be short term.

Deposition of dredged sediments on benthic habitat

Negligible impacts on Dugong are anticipated as a result of the deposition of dredged sediments on benthic habitats and therefore no specific mitigation is warranted. However, a summary of proposed mitigation measures as outlined in the draft DMP's is provided below (subject to further consultation with DSEWPaC and EHP), which would further reduce the impact on Dugong relating to deposition of dredged sediments on benthic habitats:

- mechanical devices, such as turbidity-reducing valves within overflow pipes on the TSHD would be used;
- hopper doors would be kept in good condition to minimise loss of sediment during transport;
- the TSHD would be equipped with below keel discharge of tail waters via an anti-turbidity control valve; and,
- accurate positioning systems to ensure dredging and disposal occur in approved areas.

Entrainment in dredge

The mitigation measures to reduce the impacts on Dugongs from entrainment in dredge equipment are the same as those detailed in **Section 9.3.5.1** for Estuarine Crocodiles. In addition, the following proposed mitigation measures (subject to further consultation with DSEWPaC and EHP), would also be implemented:

- mobile dredging operations:
  - would not commence if Dugongs are observed within 300m of the dredge; and,
  - where underway, would alter course if Dugongs are likely to be struck or captured.
- stationary dredging operations:
  - would not commence if Dugongs are observed within 300m of the dredge; and,
  - would cease if Dugongs are observed within 50m of the dredge head.
- operating procedures that minimise the risk from all activities of injury to marine species of conservation significance, must be developed prior to the commencement of dredging activities; and,
- the administering authority is to be immediately notified of any injury to any marine species of conservation significance.

The dredging and offshore spoil disposal marine mammal and marine turtle flowcharts are shown in **Figure 7-21** and **Figure 7-22** respectively

Any entrainment incident would potentially result in serious injury or death of an individual. However, with the implementation of these measures, the residual impacts on Dugongs from entrainment in dredge would be negligible and would eventuate only during dredging campaigns, so would be short term.

9.4.5.2 Marine and River Facilities Construction and Operations

Physical disturbance to benthic or intertidal habitats from piling

Negligible impacts on Dugongs are anticipated as a result of the physical disturbance to benthic or intertidal habitats associated with piling activities and therefore no specific mitigation is warranted. However, the following mitigation measures would be implemented to further reduce the impacts on Dugongs from the physical disturbances to benthic or intertidal habitats associated with piling activities: all temporary seaborne access infrastructure facilities would be removed when no longer required.

Underwater acoustic impacts from pile driving

Negligible impacts on Dugongs are anticipated as a result of underwater noise associated with piling activities and therefore no specific mitigation is warranted. However, the following mitigation measures to reduce the impacts on Dugongs from underwater noise associated with piling activities are the same as those detailed in **Section 9.3.5.2**. In addition, the following mitigation measures would also be implemented which have been derived from the assessment outlined in Section **15.3.3.1**:

- for marine and river pile driving activities, the soft start-up approach would be used to disperse Dugongs prior to normal pile driving activities commencing;
- continual marine fauna observations would be conducted for 30 minutes prior to and during marine and river pile driving activities;
- observation zones would be maintained over the distances shown in **Tables 15–6** to **Table 15–10** with a minimum observation distance of 300m maintained at all times;
- The observation zone for the likely worst case scenario (1 x 1,500mm and 2 x 1,050mm pipe piles at the Port) would be the largest zone required if three piling rigs are utilised. If a different combination is used which may result in a lower impact an appropriate observation zone may be determined in consultation with DSEWPaC;
- marine and river pile driving activities would be stopped if Dugongs enter within an exclusion zone of 100m and remain within the zone for greater than five minutes; and,
- no piling activities would commence if Dugongs are observed within the exclusion zone during visual observations prior to soft start-up.

9.4.5.3 Project-related Shipping

Underwater acoustic impacts from vessel movement

Negligible impacts on Dugongs are anticipated as a result of underwater noise associated with Project-related shipping activities and therefore no specific mitigation is warranted. However, the following mitigation measure would be implemented to further reduce the impacts on Dugongs from underwater acoustic noise associated with Project-related shipping activities:

- all vessels would operate in accordance with appropriate industry and equipment noise and vibration standards;
- RTA owned Project vessels, including on board machinery and equipment, would be maintained to a high standard and any source of excessive underwater noise would be investigated and remedied;
- regular maintenance of RTA owned vessels would be conducted to the manufacturers' specifications; and,
- where possible, leaving engines, thrusters and auxiliary plants in stand-by or running mode unnecessarily would be avoided.

Marine oil spill

The risk of marine oil spills from Project-related shipping would be reduced by measures to reduce the risk of collisions or groundings. This includes the use of tugs in port areas, qualified bridge personnel, bridge management systems including fatigue management, pilotage and Vessel Tracking Systems. The following mitigation measures would be implemented to reduce the unmitigated impacts on Dugongs from marine oil spills associated with Project-related shipping activities:

- bauxite vessels, including the hull and fuel tanks, would be kept in a good state of repair and the fleet used would consist of modern ships that are subject to an environmental and safety vetting system;
- all RTA owned vessels would have spill kits on board, and spill kits would be located at the Port, with vessel and shoreside oil spill contingency plans in place;
- no oil discharges from vessels would occur from Project-related shipping while in Australian waters other than the discharge of treated oily water from machinery spaces (oil content not exceeding 15ppm in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I);
- all bauxite vessels would have IMO approved oily water separators and high oil content alarm systems, as well as the capacity to immediately shut down any non-compliant oily water discharge and to redirect oily water to holding tanks for discharge ashore; and,
- no bulk chemicals or hydrocarbons would be stored at the proposed Port.

Although these measures reduce the risk of a marine oil spill occurring to unlikely, any incident may result in injury or mortality of a Dugong if they are exposed. Therefore, although the risk is unlikely, the residual impact of a marine oil spill from Project-related shipping activities throughout the life of the Project would still be minor and short term.

Vessel strike

Negligible impacts on Dugongs are anticipated as a result of vessel strike associated with Project-related shipping activities and therefore no specific mitigation is warranted. However, the following mitigation measures would be implemented to further reduce the impacts on Dugongs from vessel strike associated with Project-related shipping activities:

- all vessels would strictly adhere to port controls;
- the ferry operating on the Hey and Embley Rivers would use a transit lane which follows the greatest water depths to avoid significant seagrass meadows;
- any injury or death of marine species of conservation significance would be reported to EHP for inclusion in the Wildlife Stranding Database and those that may be attributable to RTA operations would be investigated to determine appropriate mitigation measures;
- large vessels would travel more slowly and under pilotage in shallow or confined marine areas where susceptible marine fauna including Dugongs are more commonly found; and,
- the passenger vessel would be limited to a speed of 6 knots in water of less than 2.5m in depth when approaching berth.

9.4.5.4 Summary of Residual Impacts on Dugongs Following Mitigation

Table 9-8 summarises the potential unmitigated construction and operational impacts that are minor or greater, the relevant mitigation measures to be implemented and the resulting residual impacts on Dugongs.

Table 9-9 summarises the potential impacts on Dugongs resulting from the Project considering proposed mitigation measures and in relation to the significant impact criteria for matters of NES (DEWHA 2009c).

Table 9-8 Summary of Potential Impacts, Mitigation and Enhancement Measures, and Residual Impacts on Dugongs

Potential Impact	Unmitigated Impact Magnitude		Relevant Mitigation and Enhancement Measures	Residual Impact Magnitude	
	Construction	Operation		Construction	Operation
Entrainment in dredge	Minor and short term (Capital Dredging)	Minor and short term (Maintenance Dredging)	Marine fauna observers on watch. Dredge design controls, e.g. exclusion devices and deflectors on dredge head. Use of suction only once the dredge head reaches the seabed.	Negligible and short term (Capital Dredging)	Negligible and short term (Maintenance Dredging)
Marine oil spill	Minor and short term (Project-related shipping)	Minor and short term (Project-related shipping)	Oil spill risk reduced by operational controls to minimise the risk of collisions or grounding as well as vessel maintenance. Oil spill contingency planning and equipment to minimise the amount of oil spilled and facilitate rapid response. No oil discharges in accordance with MARPOL.	Minor and short term (Project-related shipping)	Minor and short term (Project-related shipping)

Table 9-9 Impact Assessment Summary – Dugong

Will the proposed works…	**Dugong (*Dugong dugon*): Migratory**
… substantially modify, destroy or isolate an area of important habitat for a migratory species;	The construction of the wharf for the Port would involve pile driving. The underwater noise that would be generated by the hammer hitting the top of the pile would be of short term duration and therefore can be described as impulsive noise. The time taken to drive each pile would depend on the hardness of the seabed in each location. There is potential for marine animals in an area close to the piling to incur hearing damage as a result of the piling. It is anticipated that the construction activity would deter most marine mammals from the immediate area, however for precautionary purposes; it is proposed that a "soft-start" approach would be used to disperse animals in the vicinity prior to normal pile driving. The "soft-start" involves commencing pile driving with a partial capacity strike, or giving a warning with an underwater airgun prior to normal pile driving. The minor area of seagrass that may be impacted by dredging at the Humbug terminal is not significant in terms of a Dugong foraging resource and is not considered to be an area of important Dugong habitat. Predicted Project-related shipping activities would not modify, destroy or isolate areas of important habitat for Dugong.
… result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;	It is considered unlikely that an invasive species that is harmful to Dugong would be introduced due to the development or operation of the Project. RTA would conduct routine monitoring of the Port for marine pests, similar to that currently undertaken for Port of Weipa high-risk areas. There would be no ballast water exchange in the GBRWHA, and all vessels would be fully compliant with Australian quarantine regulations.
… seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Refer to the above for management of potential acoustic impacts during construction. Of all potential impacts, vessel strike from operation of the ferry from Hornibrook terminal to the Hey River terminal is anticipated to represent the highest risk. RTA would operate the ferry in a manner that would minimise the impacts to Dugong. Transit lanes would be defined and implemented to reduce the overall area of disturbance from ferry movements, and larger vessels would be operating in deeper water where the risk of vessel strike is low. Serious disruption to the life cycle of an ecologically significant population of Dugong within the Project area or along shipping routes is not anticipated.

9.4.5.5 National Recovery Plan and Threat Abatement Plans

There is currently no national recovery plan for Dugongs. The *Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life* (DEWHA 2009d) is listed on the SPRAT database as being relevant for the Dugong. **Table 9-10** outlines the consistency of the Project with this threat abatement plan.

9.4.6 Offsets

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012b), offsets are not required where the residual impact is not likely to be significant (when assessed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c)).

Section 9.4.4 and **Section 9.4.5** of this report document the results of the impact assessment process and concludes that with the implementation of the proposed mitigation measures, the residual impacts associated with construction and operation of the Project on Dugongs would be negligible to minor and therefore not significant as outlined in **Section 9.1.2**. As such, offsets relating to Dugongs are not required under the Commonwealth offsets policy.

Table 9-10 Consistency of SoE Project with the Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life with regard to the Dugong

Objective	Action	Consistency of the SoE Project with the Threat Abatement Plan
Contribute to the long-term prevention of the incidence of harmful marine debris	• Australian Government in consultation with the states and territories to facilitate the review of existing arrangements relevant to the control of marine debris on vessels smaller than 400 gross tonnes (including fishing vessels). • State, territory and Australian governments and appropriate local bodies to facilitate studies of port facilities and boating hubs for the disposal of fishing gear, including assessment of availability, use, capacity and cost. • State and territory governments to consider reviewing legislation to ensure that details of waste reception facilities for ships are included in port environment plans. • State and territory governments to investigate how Australia's obligations under MARPOL (i.e. to provide adequate waste reception facilities for ship waste) are encompassed in domestic legislation and policies. • Australian Government agencies to facilitate through international fora, taking into account policies and programs of IMO, studies of the ability of international ports in the Asia-Pacific region to handle vessel-sourced waste, particularly derelict fishing gear, including assessment of availability, capacity and cost. • Australian Government agencies to facilitate through domestic and international fora, taking into account policies and programs of IMO, studies of the barriers and incentives to the use of existing port waste reception infrastructure in Australia and the Asia-Pacific region. • Australian Government agencies in collaboration with state and territory governments to identify appropriate responses and responsibilities for recovery of hazardous debris at sea, notably large derelict fishing nets. • State, territory and Australian governments, in collaboration with industry, to identify and implement appropriate measures for incorporating waste reporting and management requirements (reporting and return of rubbish, damaged gear, etc. to port for disposal) into fishery management arrangements as appropriate. • State, territory and Australian governments, in collaboration with the fishing industry, to promote best practice waste management strategies on board fisheries vessels, including the uptake of existing codes of conduct, and identify any need for the development of new codes of conduct.	Consistent: • all vessels would operate in full compliance with international and Australian regulations with respect to the treatment and discharge of operational wastes; • no garbage or sewage would be discharged in the Port area and on-board garbage management plans and systems would reduce the risk of accidental loss of waste overboard; • no operational discharges from vessels would occur from Project-related shipping while in Australian waters other than the discharge of treated oily water from machinery spaces (oil content not exceeding 15ppm in accordance with MARPOL Annex I); • Project vessels would not discharge any garbage while at sea within the Port area, GBRMP or parts of the Torres Strait defined as "nearest land"; and, • Project vessels would have on-board garbage management plans and systems to minimise the risk of accidental loss overboard of garbage, particularly plastics; all Project vessels would have an on-board sewage treatment plant that is IMO approved, holding tanks and discharge connections to allow discharge at shore facilities or holding until the vessel is outside Australian Waters.

Objective	Action	Consistency of the SoE Project with the Threat Abatement Plan
	• Australian Government agencies to support an analysis of financial incentives to encourage return of waste generated at sea to land for appropriate disposal. • Australian Government agencies to support feasibility studies of market/consumer/peer-based incentives to encourage responsible handling and disposal of waste fishing gear. • State, territory and local governments and other relevant bodies to consider providing increased funding for the introduction of improved solid pollutant (particularly litter) control strategies in waterways. • State and territory governments to facilitate an analysis of the effectiveness of current litter public awareness and education campaigns to identify gaps and areas for improvement. • State, territory and Australian governments, in collaboration with appropriate non-government organisations, to develop options for establishing a more consistent and long-term national approach to litter abatement education, particularly for marine-based activities. • Australian Government agencies to examine introducing awareness-raising and outreach programs aimed at relevant groups contributing to marine debris in the Asia-Pacific region • Australian Government agencies to identify opportunities for exchange visits between coastal (especially Indigenous) communities experiencing the impacts of marine debris and groups in other nations where large proportions of harmful marine debris originate. • Australian Government agencies to strengthen relations with regional neighbours on marine debris through relevant fora, and develop collaborative project proposals to address the sources and impacts of harmful marine debris. • Australian Government to encourage and assist relevant nations to sign, ratify and enforce Annex V of MARPOL.	
Remove existing harmful marine debris from the marine environment Monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction in marine debris	• Australian Government agencies in collaboration with state and territory governments and other relevant stakeholders to support the development of nationally consistent, statistically rigorous data collection protocols and survey methods. DEWHA to support the development and management of national mapping of the spatial distribution and concentration of marine debris over time to assess the significance of marine debris and to reduce its occurrence. • State, territory and Australian governments to provide support for community-based coastal and waterway clean-up and monitoring activities.	Not applicable.

Objective	Action	Consistency of the SoE Project with the Threat Abatement Plan
	• Australian Government agencies in collaboration with state and territory government to facilitate the establishment of a national network of a limited number of permanent marine debris monitoring sites (including within Commonwealth Marine Protected Areas) to promote consistent monitoring and information gathering and exchange, to enable understanding of long-term trends, and to inform adaptive and effective management responses. • Australian Government agencies to support a study on the wind and sea circulation patterns in the Asia-Pacific region as a basis for better understanding the pathways and potential sources and sinks of harmful marine debris of foreign origins in Australian waters. • Australian Government to facilitate a feasibility study on introducing marking of fishing gear so that it may be identified as originating from a specific fishery. The feasibility study will also consider the practical implications of marking fishing gear and the implications of derelict gear being traced back to fisheries operations.	
Mitigate the impacts of harmful marine debris on marine species and ecological communities	• State, territory and Australian governments to support expanded and consistent, long-term monitoring, investigation, recording and management of data on vertebrate marine life harmed and killed by the physical and chemical impacts of marine debris. This information will assist the impacts of different types of marine debris on vertebrates to be quantified and characterised. • Australian Government to coordinate marine debris abatement strategies identified in existing marine wildlife recovery plans. • Australian Government to support research on the nature of degradation pathways of synthetic debris in the marine environment (including biodegradable and oxodegradable plastics), the extent that degradation products are contaminated by other potentially toxic compounds, and the potential toxicity of debris types on marine species. • Australian Government to identify measures to promote the uptake and application of biodegradable and oxodegradable plastic in marine-based industries and environments where it is found to be effective.	Not applicable.

9.5 Cetaceans

Three cetacean species were identified in **Section 4.4.2.5** as known, likely or possibly occurring in the Project area. These species are:

- Australian Snubfin Dolphin (*Orcaella heinsohni*) - listed as migratory under the EPBC Act. Known to occur within the area of the proposed Port. Likely to occur within the areas of the proposed Hey and Embley River Ferry/Barge terminals. Possibly occurs within the area of the proposed new spoil ground and Albatross Bay spoil ground;
- Indo-Pacific Humpback Dolphin (*Sousa chinensis*) - listed as migratory under the EPBC Act. Known to occur within the proposed Port and Hey and Embley River Ferry/Barge terminals area. Possibly occurs within the area of the proposed new spoil ground and Albatross Bay spoil ground; and,
- Bryde's Whale (*Balaenoptera edeni*) - listed as migratory under the EPBC Act. Possibly occurs within the area of the proposed Port, proposed new spoil ground and Albatross Bay spoil ground.

The assessment for each of these species is provided in the following sections.

9.5.1 Species Profiles

9.5.1.1 Australian Snubfin Dolphin

Regional Distribution and Population

The Australian Snubfin Dolphin (*Orcaella heinsohni*) is listed as migratory under the EPBC Act.

The Australian Snubfin Dolphin is found in subtropical and tropical waters between Brisbane and Broome. This species is likely to be endemic to Australian waters with only one record of the species occurring outside of Australia in Papua New Guinea (DSEWPaC 2012q). Its status in Queensland waters is very poorly known, and there is very limited information relating to the distribution and abundance of the species within the Gulf of Carpentaria.

Aerial survey in the western Gulf of Carpentaria (which includes the Project area) estimated a population of about 1,000 Australian Snubfin Dolphins (Freeland and Bayliss 1989). However, the estimate has been questioned due to the known difficulty of identifying dolphin species in turbid waters from the air (Parra *et al.* 2002a). Based on the low numbers of Australian Snubfin Dolphins sighted during aerial and boat based surveys of the east coast of Queensland (Parra *et al.* 2002b, Parra *et al.* 2006) the population at a regional level (Queensland) is likely to be in the thousands rather than tens of thousands (Parra *et al*. 2002b). DSEWPaC (2012q) suggests that, considering the length of coastline and area of suitable shallow habitat and the apparent occurrence of Australian Snubfin Dolphins in small localised groups, it is likely that mature Australian Snubfin Dolphins do not number more than 10,000 individuals.

The home ranges and/or territories for the Australian Snubfin Dolphin appear to be large (Parra 2006). Data on the migratory pathways of this species are limited. However, a recent study showed Australian Snubfin Dolphins exhibit some degree of residency. A four year study by Parra *et al.* 2006 found a mean population of 14 individuals at any one time within a 310km^2 study area within Cleveland Bay (Townsville) and they appear to reside in the study area for an average of 30 days, and then spend an average of 48 days outside before returning. Palmer *et al.* (2010) found that numbers of Australian Snubfin Dolphins were similar in both wet and dry seasons in the Cobourg Marine Park (Northern Territory) and Palmer (2010) reports the same finding for Darwin Harbour.

Figure 9-6 illustrates combined data from known records and sightings of cetaceans during surveys conducted for the Project in the eastern Gulf of Carpentaria.

Project Boundary
Locality
River / Creek
Road / track

SOURCES: *Greenland *et al.* (2004)

Australian Snubfin Dolphin *(Orcaella heinsohni)*

- Stranding Mortality Database Record*
- Incidental Observation

Indo-Pacific Humpback Dolphin *(Sousa chinesis)*

- EIS Survey Record
- Incidental Observation
- (2) Number of records at location

NOTE: Incidental observations were recorded during field survey and described in relation to local geographic features.

South of Embley Project

Fig. 9-6: Cetacean Records (eastern Gulf of Carpentaria)

N

0 150km

Datum/Projection: GDA94/MGA Zone 54 Date: 18/10/2012

Life Cycle

The life history of the Australian Snubfin Dolphin is not well known, with the majority of information estimated from the closely related Irrawaddy Dolphin (*Orcaella brevirostris*). The Australian Snubfin Dolphin is usually seen in groups of five to six animals, but groups of up to 15 animals have been observed. They may reach an age of 28 years, and maximum lengths of 2.7m in males and 2.3m in females (DSEWPaC 2012q).

The reproductive characteristics of the Australian Snubfin Dolphin are likely to be similar to the Irrawaddy Dolphin. Gestation for Irrawaddy Dolphins lasts 14 months (captive animal) and calves are born in August or September. It is possible that breeding of Australian Snubfin Dolphins occurs year round based on observations of social activity and calves in Cleveland Bay (Townsville) (DSEWPaC 2012q).

Ecology and Habitat

The Australian Snubfin Dolphin inhabits shallow coastal waters less than 20m deep and is often associated with tidal riverine and estuarine systems, enclosed bays and coastal lagoons (Corkeron *et al.* 1997, Hale *et al.* 1998, Jefferson 2000, Parra *et al.* 2006) and has preference for seagrass associated with river mouths (Parra, 2006). The species is found in areas of coastal development, including extensive port facilities such as the Port of Brisbane and Cleveland Bay (Townsville) including dredged channels and breakwaters (Hale *et al.* 1998, Parra *et al.* 2006).

The co-existence of small cetaceans in general with coastal development and other anthropogenic disturbances is likely to relate to their plasticity of habitat use, opportunistic foraging strategies, as well as their ability to adapt behaviourally to changing circumstances. The most significant responses by dolphins to anthropogenic disturbances occur with respect to boat based dolphin tourism, presumably as a result of vessels specifically pursuing animals and moving fast and unpredictably (Constantine 2004, Christiansen *et al*. 2010) and food provisioning by trawl vessels (Chilvers *et al*. 2003, Piwetz *et al*. 2012). In comparison, predictable vessel movements such as from a ferry crossing a river on a set course result in substantially less impact on dolphin behaviour, and impacts that may occur are not necessarily ecologically meaningful (Constantine *et al*. 2004, Lusseau *et al*. 2006, Piwetz *et al*. 2012).

The diet of the Australian Snubfin Dolphin has been identified through the analysis of stomach contents of stranded animals. This study identified fish (24 taxa), cephalopods (five taxa), decapods (five taxa) and bivalves as the main prey. The prey species identified indicate that the species is an opportunistic-generalist that forages throughout the water column in shallow, inshore and estuarine habitats (Parra and Jedensjo 2009).

Threats

The incidental capture of Australian Snubfin Dolphins in gillnets and the nets used for the Queensland Shark Control Program are key threats to their populations (Parra *et al.* 2006). Other threats identified in Queensland include prey depletion due to overfishing, and inshore pollution and habitat modification arising from coastal development. Noise, interference and collisions from boat and jet ski activity may also harm this species or affect their natural behaviour (Parra *et al.* 2006). The SPRAT database (DSEWPaC 2012q) identifies the following threats to the Australian Snubfin Dolphin:

- habitat destruction and degradation;
- incidental capture in and nets;
- competition with fisheries;
- pollution of habitat;

- interaction with vessels;
- pathogens; and,
- slow reproductive rate.

The pressure analysis outlined in The Species Group Report Card – Cetaceans: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012l) determined that "physical habitat modification resulting from onshore construction" was of concern for dolphins. Specifically, DSEWPaC (2012l) states:

> *"Habitat modification (associated with construction and dredging activities) from coastal development is considered one of the greatest threats to inshore dolphins"*

Directly related to this pressure is dredging and dredge spoil disposal which is assessed by DSEWPaC 2012l as of potential concern to dolphins.

9.5.1.2 Indo-Pacific Humpback Dolphin

Regional Distribution and Population

The Indo-Pacific Humpback Dolphin (*Sousa chinensis*) is listed as migratory under the EPBC Act.

The global range of the Indo-Pacific Humpback Dolphin extends through the Indo-Pacific region from eastern South Africa to northern Australia. Within Australia, the species ranges from the Queensland/New South Wales border, north through to Exmouth in Western Australia. There are few records of the species between the Gulf of Carpentaria in the north and Exmouth Gulf in the west, however this is likely due to a lack of research effort and the remoteness of the area (Bannister *et al.* 1996, Parra *et al.* 2002a). Known localities for the species in Queensland include the GBRMP, Moreton Bay, the lower reaches of the Brisbane River, and adjacent offshore waters. A hotspot of Indo-Pacific Humpback Dolphins occurs on the western side of Bathurst Head, zoned as a Special Management Area, in the Far Northern Section of the GBRMP (Parra *et al.* 2006).

Australian populations are discrete and geographically localised. The total population number in Australian waters is unknown (Parra *et al.* 2004). Regional population estimates (Queensland) are likely to be in the order of thousands rather than tens of thousands (Parra *et al.* 2002b).

Home ranges for the Indo-Pacific Humpback Dolphin appear to be large and there are no extreme seasonal fluctuations in population numbers (Jefferson and Karczmarski 2001). Data on the migratory pathways of this species is limited. A four year study by Parra *et al.* (2006) found a mean population of 10 individuals at any one time within a 310km^2 study area within Cleveland Bay (Townsville) and they appear to reside in the study area for an average of 141 days, and then spend an average of 109 days outside before returning. Palmer *et al.* (2010) found that numbers of Indo-Pacific Humpback Dolphins were similar in both wet and dry seasons in the Cobourg Marine Park (Northern Territory) and Palmer (2010) reports the same finding for Darwin Harbour.

Figure 9-6 illustrates combined data from known records and sightings of cetaceans during surveys conducted for the Project in the eastern Gulf of Carpentaria.

Life Cycle

Indo-Pacific Humpback Dolphins may live to more than 40 years old (Bannister *et al.* 1996, Ross *et al.* 1994) with females maturing at approximately 10 years of age, and males at approximately 13 years of age (Jefferson and Karczmarski 2001, Ross 2002). Adults may be found singly or in pairs, while immature individuals tend to associate with groups containing more than one adult. Group size is generally four to seven individuals, but may be as large as 25 (Ross 2002). Larger groups of Indo-Pacific Humpback Dolphins are comprised of all age classes, with adults representing between one half and two thirds of the group (Jefferson and Karczmarski 2001).

Indo-Pacific Humpback Dolphins are believed to breed year round, however calving generally occurs during summer months between December and February (Jefferson and Karczmarski 2001). Gestation lasts between 10 and 12 months (Cockcroft 1989) and calving intervals of three years have been estimated for populations in South Africa (Kaczmarksi 1996, 1999). Calving areas in Australian waters remain unknown (Bannister *et al.* 1996).

Ecology and Habitat

Indo-Pacific Humpback Dolphins inhabit shallow coastal, estuarine, and occasionally riverine habitats, in tropical and subtropical regions. The species usually occurs close to the coast, but they have been seen in shallow water up to 55km offshore (Corkeron *et al.* 1997, Jefferson 2000). Their distribution appears to be limited to waters of the continental shelf, and the only places where they range far offshore are where the water remains shallow. Recent surveys conducted in the Far Northern Section of the GBRMP indicate that the species is associated with waters less than 15m deep, 15-36°C in temperature, within 5km of land and 20km of the nearest river mouth (Jefferson and Karczmarski 2001, Parra *et al.* 2006, Ross *et al.* 1994, Sutaria and Jefferson 2004).

Core use areas for the Indo-Pacific Humpback Dolphin are close to river mouths including dredged channels and breakwaters (Hale *et al*. 1998, Parra 2006, GHD 2009). The peer reviewed literature demonstrates that dolphins, and in particular the Indo-Pacific Humpback Dolphin co-exists with coastal developments including port developments (Hale *et al*. 1998, Chilvers *et al*. 2005, Parra 2006). In comparing key river mouth habitat in areas with and without major port developments, the broad scale habitat use of Indo-Pacific Humpback Dolphins is similar. It is not the case that Indo-Pacific Humpback Dolphins are “forced” to co-exist with such developments, they remain in such locations and indeed may preferentially choose them, even when alternative and less disturbed habitats are available within an embayment (Chilvers *et al*. 2005, Parra 2006).

The co-existence of the small cetaceans in general with coastal development and other anthropogenic disturbances is likely to relate to their plasticity of habitat use, opportunistic foraging strategies, as well as their ability to adapt behaviourally to changing circumstances. The most significant responses by dolphins to anthropogenic disturbances occur with respect to boat based dolphin tourism, presumably as a result of vessels specifically pursuing animals and moving fast and unpredictably (Constantine 2004, Christiansen *et al*. 2010) and food provisioning by trawl vessels (Chilvers *et al*. 2003, Piwetz *et al*. 2012). Predictable vessel movements such as from a ferry crossing a river on a set course result in substantially less impact on dolphin behaviour, and impacts that may occur are not necessarily ecologically meaningful (Constantine *et al*. 2004, Lusseau *et al*. 2006, Piwetz *et al*. 2012).

Indo-Pacific Humpback Dolphins display no apparent preference for clear or turbid waters, and have been reported from a variety of coastal habitats, including coastal lagoons and enclosed bays with mangrove forests, seagrass beds and rocky and/or coral reefs. Although habitat use varies between different geographic regions, habitat use is well defined and persistent at each location (Jefferson and Karczmarski 2001).

Diet studies indicate that Indo-Pacific Humpback Dolphins are opportunistic generalists that forage for prey that occurs throughout the water column in shallow, inshore and estuarine habitats (Jefferson and Karczmarski 2001, Parra and Jedensjo 2009, Ross 2002). The species consumes a wide variety of nearshore, estuarine and reef fishes as well as cephalopods and bivalves.

Threats

Incidental mortality in fishing gear and habitat degradation and loss are the greatest threats to the Indo-Pacific Humpback Dolphin throughout its range (Ross *et al.* 1994, Jefferson and Karczmarski 2001). In the northwest Indian Ocean, they have been hunted for human consumption and oil. Anti-shark gillnets off southeast Africa and eastern Australia may also pose a threat to the sustainability of this species (Parra *et al.* 2002b, Paterson 1990).

Coastal development that degrades mangrove and seagrass habitats may also pose a threat to this species as these communities support the recruitment of species commonly preyed on (Bannister *et al.* 1996). Marine construction activities, such as pile-driving during pier and bridge construction, may also cause acoustic disturbance. Vessel traffic may interfere with the Indo-Pacific Humpback Dolphin's acoustic communication (Van Parijs and Corkeron 2001). Other threats to the Indo-Pacific Humpback Dolphin include overfishing of prey species, marine pollution and poisoning (Cosser 1997, Gaus *et al.* 2001).

The SPRAT database (DSEWPaC 2012q) identifies the following threats to the Indo-Pacific Humpback Dolphin:

- habitat destruction and degradation;
- by catch;
- illegal killing;
- live capture;
- competition with fisheries;
- pollution;
- wildlife tourism; and,
- vessel traffic.

The pressure analysis outlined in The Species Group Report Card – Cetaceans: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012l) determined that "physical habitat modification resulting from onshore construction" was of concern for dolphins. Specifically, DSEWPaC (2012l) states:

> "*Habitat modification* (associated with construction and dredging activities) *from coastal development is considered one of the greatest threats to inshore dolphins"*

Directly related to this pressure is dredging and dredge spoil disposal which is assessed by DSEWPaC 2012l as of potential concern to dolphins.

9.5.1.3 Bryde's Whale

Regional Distribution and Population

The Bryde's Whale (*Balaenoptera edeni*) is listed as migratory under the EPBC Act.

No subspecies are currently recognised for the Bryde's Whale (Rice 1998), but two distinct forms (inshore/coastal and offshore) are found off South Africa (Best 1977) and Japan (Kawamura and Satake 1976, Sasaki *et al.* 2006). The species is found in tropical and warm temperate waters exceeding 16°C, but generally in the 20°C isotherm, between 40°N and 40°S (Bannister *et al.* 1996,

Kato 2002). Some populations of Bryde's Whales may migrate seasonally, moving towards higher latitudes during the summer and towards the equator during the winter. Other populations of Bryde's Whales are residents and do not migrate, a behaviour that is unique among baleen whales.

Bryde's Whales have been recorded in all Australian states except the Northern Territory (Bannister *et al.* 1996), including one sighting each in Victoria and New South Wales and 11 reported strandings: South Australia (seven), NSW (two), Victoria (one) and Queensland (one) between 1996 and 2010 (DSEWPaC 2012k).

There are no estimates of the global population size of Bryde's Whales and similarly, no information exists regarding trends of the Bryde's Whale population in Australia.

There are no published records for the Bryde's Whale within the Gulf of Carpentaria, however anecdotal observations from local fishermen identify the Bryde's Whale within the Weipa region. The SPRAT database (DSEWPaC 2012k) states that it is likely that Australian inshore stocks of Bryde's Whales will be small, possibly of similar size to those off South Africa, which is estimated at 582 ± 184 animals (Best *et al.* 1984). It is therefore unlikely that significant numbers would occur in the vicinity of the Project area.

Life Cycle

Bryde's Whales may reach over 50 years in age. Bryde's Whales are not gregarious and mostly swim alone or in pairs. Large group sizes of 10 to 20 individuals are usually loose aggregations spread out over a few square kilometres (Martin 1990). The association of individuals is possibly connected to a common activity, such as feeding or mating (DSEWPaC 2012q).

The age at sexual maturity is between seven and nine years (Kato 2002, Rice 1998). Bryde's Whales breed in alternate years, apparently through the year but with a peak in autumn. Their gestation period is estimated at 12 months. Calves are between 3.4m and 4.0m long at birth and weigh 1,000 kilograms. The mother nurses for 6–12 months (Jefferson *et al.* 2008). Inshore coastal forms of the species appear to breed and give birth throughout the year (Best 1977), while the offshore form appears to have a protracted breeding and calving season over several months during winter (Kato 2002).

Ecology and Habitat

The inshore form of Bryde's Whale appears to be limited to the 200m depth contour, moving along the coast in response to availability of suitable prey (Best *et al.* 1984). The offshore form is found in deeper water (500 to 1,000m).

The Bryde's Whale is considered to be an opportunistic feeder, readily consuming whatever shoaling prey is available (Kato 2002, Martin 1990). Bryde's Whales use several feeding methods, including skimming the surface, lunging, and bubble nets (Reeves *et al.* 2003). They regularly dive for about five to 15 minutes (maximum of 20 minutes) after four to seven blows at the surface. It appears that the coastal and offshore forms may be distinguished by their prey preferences (Best 1977), with the smaller coastal Bryde's Whale feeding on schooling fishes, such as pilchard, anchovy, sardine, mackerel, herring and others. In contrast, the larger offshore form appears to feed on small crustaceans such as euphausids, copepods and pelagic red crabs, plus cephalopods (Best 1960, 1977, Kawamura 1980, Nemoto and Kawamura 1977, Ohsumi 1977).

Threats

Bryde's Whales are not usually taken incidentally or injured in fishing operations, but fishing remains a potential threat (DSEWPaC 2012q). This species was not significantly targeted as part of the historical commercial whaling harvest, but the Japanese have hunted this species as part of their scientific research whaling program.

Notwithstanding these threats, the Bryde's Whale is not considered to be in danger or have suffered substantial population declines (Martin 1990). Given its more temperate distribution, Bryde's Whales have been subject to lower whaling impacts than other Southern Hemisphere baleen whales. It is thought that Bryde's Whale stocks have remained relatively stable due to exploitation being controlled and monitored under the post-1975 *New Management Procedure* of the International Whaling Commission (Kato 2002).

Pollution, including increasing amounts of plastic debris at sea (DEH 2002), oil spills and dumping of industrial wastes into waterways and the sea are leading to bio-accumulation of toxic substances in body tissues of marine mammals. The coastal form of Bryde's Whale may be particularly threatened by discarded plastic (DEH 2002).

Other current and future threats to Bryde's Whales include seismic and/or defence operations, collisions with large vessels, and entanglement in fishing gear (Bannister *et al.* 1996). In addition, competition with commercial fisheries, particularly for species such as anchovy, may also affect these animals (Bannister *et al.* 1996).

The SPRAT database (DSEWPaC 2012q) identifies the main threats to Bryde's Whales as:

- ingestion of discarded plastic;
- pollution;
- disturbance (possibly from seismic and/or defence operations);
- collisions with large vessels; and,
- entanglement in fishing gear.

9.5.2 Cetacean Survey Methodology and Results

9.5.2.1 Survey Methods

There are no specific Australian survey guidelines for cetaceans. DSEWPaC's (2011c) *Survey Guidelines for Australia's Threatened Mammals* do not include guidelines for the survey of Australian Snubfin Dolphin, Indo-Pacific Humpback Dolphin or Bryde's Whale. Both Dolphin species are difficult to detect as they are inconspicuous, tend to live in small groups, and tend to occur in turbid waters. Obtaining accurate and precise estimates of the abundance of cetaceans is usually difficult, expensive and time consuming (Para *et al.* 2006). Within the timeframes and scope of a typical environmental impact assessment for a particular project, and taking into consideration the nature and behaviour of these species, surveys are typically limited to identifying the presence of the species within the project area. In order to determine population estimates and/or site specific habitat utilisation more intensive surveys would be required over a significantly greater time scale which is typically outside the scope of an environmental impact statement.

Field investigations were conducted in 2007, 2008, 2009, 2010 and 2012 to undertake benthic habitat mapping to determine the presence of suitable habitat for migratory cetaceans within the Project area. Investigations aimed to assess the value these habitats are likely to have at a local/regional scale. Incidental observations of cetaceans were recorded during these field investigations. A desktop literature search for records of the species was also undertaken.

Surveys for cetaceans were conducted in August 2012 coinciding with the netting survey for EPBC Act listed threatened sawfish and shark species. Nine days of survey were carried out (comprising both dedicated and incidental observations); two days (total 33 hours observation) in the Boyd Point area, three in Norman Creek estuary (total 21 hours observation) and four days in the Hey River (total 18.5 hours observation) and Embley River (total 14.5 hours observation) estuary. Six days of survey were carried out on board the dedicated dolphin spotting vessel at Boyd Point and in the Hey and Embley estuary and three days were conducted on board the netting vessel within the Norman Creek estuary. Survey was conducted from the mid-ebb tide to mid-flood tide (over the lower half of the tidal cycle) which allowed observations to be made over a substantial portion of the tidal cycle. The survey covered an area totally about 226km^2 (refer **Figure 9-7**).

Observations were carried out by a Joint Nature Conservation Committee (JNCC) qualified Marine Mammal Observer (MMO) at all locations and a Traditional Owner with considerable local hunting experience for the two days at Boyd Point and one day in Norman Creek. Spotting from the dedicated spotting vessel involved anchoring for an hour at a predetermined position and constantly scanning the area for any cetacean activity. After an hour the spotting vessel was then repositioned to another location within the survey area for another hour to increase the area covered during the spotting effort. When the MMO was required to support the netting survey, observations were made from the netting vessel upstream and downstream of the netting locations during periods when nets were not being checked. This typically allowed for up to 45 minutes of dedicated observations per hour between checking of the nets.

If any cetaceans were spotted, identification was attempted by examining defining features (including dorsal fin shape and size, melon size, presence or absence of beak, colouration) and behaviours of the animals. Position relative to the boat was documented as well as direction of travel, activity and habitat type. Where possible, photographs were taken of cetacean species observed, to allow for subsequent review of identifications.

9.5.2.2 Survey Limitations

Weather constraints were the main limiting factor as increased winds during most afternoon-evening periods gave rise to swells and numerous white caps which could hamper the ability to identify any cetaceans sighted.

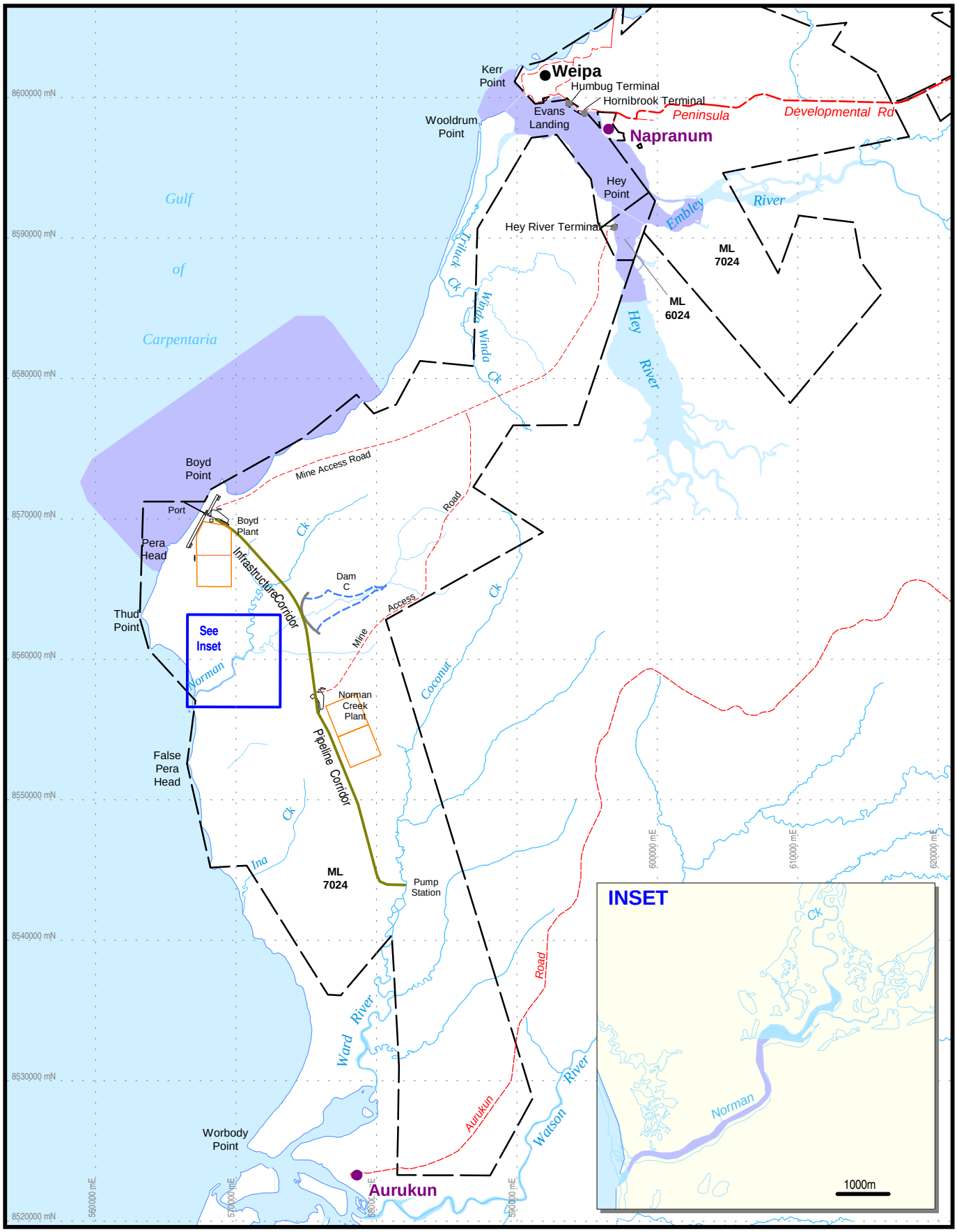
Sun glare on the water and lack of light in the pre-dawn, late afternoon and evenings can also reduce the ability to spot any cetaceans in the area. The spotting vessel continued to observe in these conditions while it was available as a support vessel for the netting survey.

Occasionally cetaceans may be spotted momentarily without affording the observer enough time to confidently identify to species level.

Regional variations in colouration or morphology of observed cetaceans could also lead to misidentification of species however, the survey techniques employed were considered comprehensive enough to conclude the presence or absence of these species and any habitat associations in the area at the time of the observation period.

Combined data from known records in the eastern Gulf of Carpentaria and sightings of cetaceans during surveys conducted for the Project are shown in **Figure 9-6**.

The review of available secondary source information (refer **Section 9.5.1.1**) identified that the Gulf of Carpentaria may contain up to 1,000 individuals of this species (although the taxonomy was not confirmed). Field surveys verified the presence of suitable shallow coastal, tidal riverine and estuarine habitats for the Australian Snubfin Dolphin within the Project area.



RTA Mining Lease boundary
Locality
Drainage
Road/track
Tailings storage facility
Cetacean survey site

Rio Tinto Alcan

South of Embley Project

Fig. 9-7: Cetacean Survey Sites

N

5 0 5 10Km

1:375000

Datum/Projection: GDA94/MGA Zone 54 Date: 01/11/2012

However, the high variability of conditions within the Project area and transient nature of the Australian Snubfin Dolphin means that population numbers of this migratory species in the Project area will vary considerably. It is estimated that the proportion of suitable habitat in the Project area is approximately 1% of suitable habitat in the Gulf of Carpentaria. Assuming the population is proportional to the presence of suitable habitat, an average of about 10 individuals may be present in the vicinity of the Project area at any one time.

9.5.2.3 Results - Indo-Pacific Humpback Dolphin

Incidental observations while undertaking the habitat mapping at the proposed Port between 2007 and 2010 confirmed the presence of Indo-Pacific Humpback Dolphins in the area. The nine day targeted cetacean surveys in August 2012 confirmed the presence of Indo-Pacific Humpback Dolphins within the Embley River estuary (14 individuals) and at Boyd Point (4 individuals).

Combined data from known records in the eastern Gulf of Carpentaria and sightings of cetaceans during surveys conducted for the Project are shown in **Figure 9-6**.

The general overall paucity in data for Indo-Pacific Humpback Dolphin populations in Australia means it is not possible to quantify the distribution and abundance of the species within the vicinity of the Project area. However, given that the total Australian population is thought to be in the thousands rather than the tens of thousands and the geographic range of the species, it is likely that the local population will not be large (refer **Section 9.5.1.2**). Field surveys verified the presence of suitable shallow coastal, tidal riverine and estuarine habitats for the Indo-Pacific Humpback Dolphin within the Project area. However, the high variability of conditions within the Project area and transient nature of the migratory Indo-Pacific Humpback Dolphin means that population numbers in the Project area will vary considerably. It is estimated that the proportion of suitable habitat in the Project area is approximately 1% of suitable habitat in the Gulf of Carpentaria. Assuming the population of Indo-Pacific Dolphins in the Gulf of Carpentaria is similar to the Snubfin Dolphin and is proportional to the presence of suitable habitat, an average of about 10 individuals may be present in the vicinity of Project area at any one time. This number is consistent with the 18 individuals observed during the targeted survey. It is also comparable with the mean population found in Cleveland Bay (Townsville) by Parra *et al.* (2006).

9.5.2.4 Results - Bryde's Whale

There have been no specific surveys of Bryde's Whales within Australian waters. Most of the information about the species has come from Japanese fisheries researchers and from the work by Best (1960, 1977) in South Africa.

There are no data within the literature that allows for an estimate of the Bryde's Whale population within the vicinity of the Project area or the greater Gulf of Carpentaria region (refer **Section 9.5.1.3**). Similarly there is a lack of information regarding the migratory habits of the species and habitat use as it may be applied to the Project. There have been no confirmed Bryde's Whale sightings or stranding's in the Project area. Based on a combination of the secondary source information and the lack of any observation of this species in the area and limited suitable habitat, it is considered likely that abundance would be very low, if it occurs at all.

9.5.3 Likelihood of Occurrence within the Project Area

The likelihood of occurrence of Australian Snubfin Dolphins, Indo-Pacific Humpback Dolphins and Bryde's Whales in the Project area and along shipping routes are presented in **Table 9-11**, **Table 9-12** and **Table 9-13** respectively. The potential habitat of Australian Snubfin Dolphin and Indo-Pacific Humpback Dolphin is presented in **Figure 9-8** to **Figure 9-9** respectively.

Table 9-11 Profile Summary – Australian Snubfin Dolphin

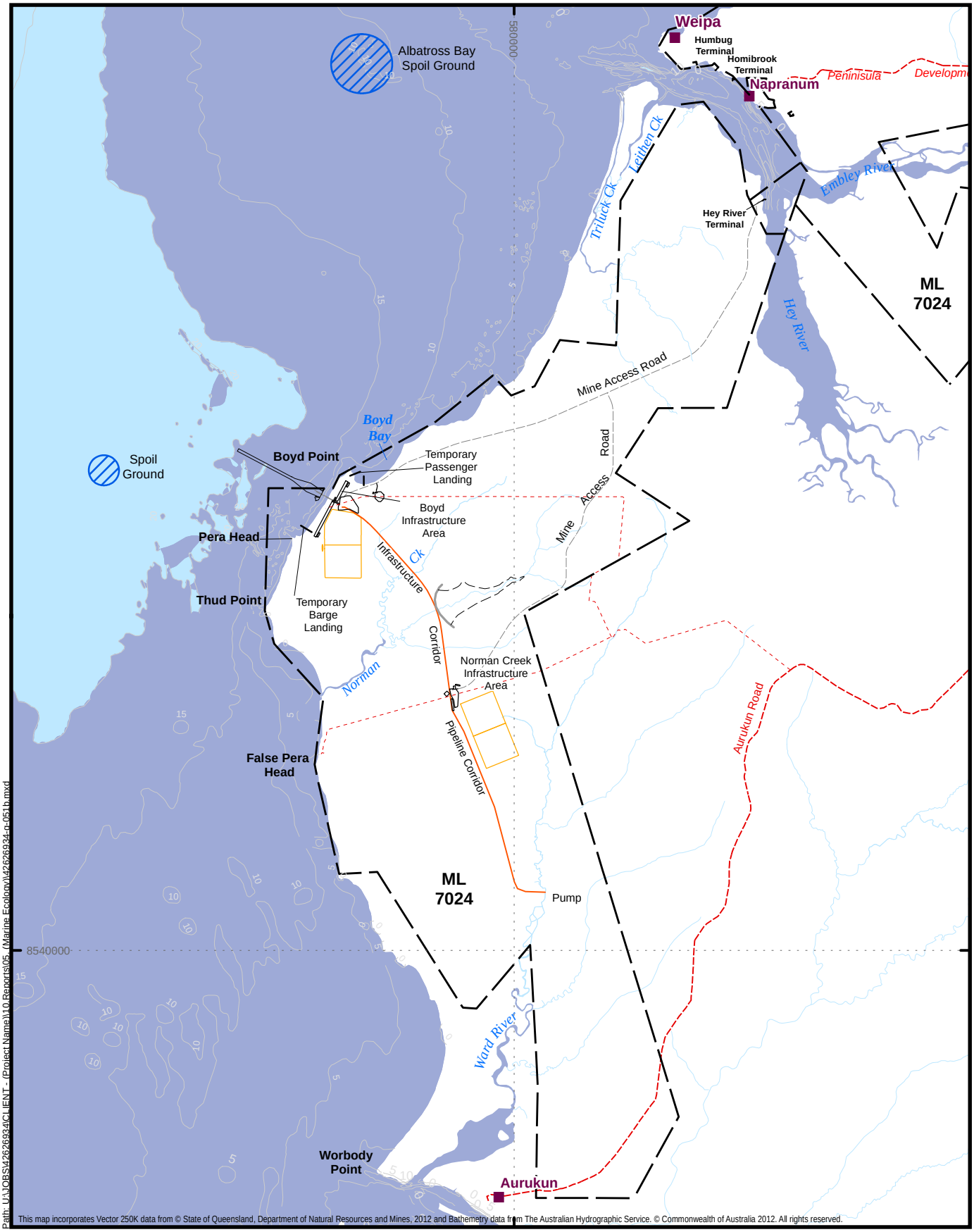
Species	Habitat Preferences			Known / estimated population	Likelihood of Occurrence
	Foraging	**Breeding**	**Migratory**		
Australian Snubfin Dolphin (*Orcaella heinsohni*) (Migratory)	Shallow waters (<20m depth), often associated with tidal riverine and estuarine systems, enclosed bays and coastal lagoons.	Unknown. No calving areas are known in Australian waters, but a near-term foetus and a neonate are recorded from Townsville.	Unknown. Potentially have a large home range from which they follow a model of emigration and immigration for particular habitat areas.	Regional population levels (e.g. Queensland) are likely to be in the order of thousands rather than tens of thousands. Likely to be endemic to Australian waters.	**Proposed Port Site** **Known to Occur**: Incidental sightings of this species were recorded in the vicinity of the proposed Port footprint during field studies. **Proposed New Spoil Ground** **Possible**: No incidental sightings were recorded. This species usually inhabits shallow coastal waters less than 20m deep and are often associated with coastal and estuarine waters, enclosed bays and coastal lagoons. The proposed new spoil ground is in deeper water than this and therefore it is unlikely to represent preferred habitat for this species. However, it is possible they may migrate through the area. **Albatross Bay Spoil Ground** **Possible**: No incidental sightings were recorded. The Albatross Bay spoil ground is primarily characterised as flat, unvegetated soft sediments habitat, and is therefore unlikely to support sufficient densities of prey species to be considered preferred habitat for this species. However, it is possible that this species may migrate through or opportunistically feed in the area. **Ferry/Barge Terminals – Hey and Embley Rivers** **Likely**: No incidental sightings were recorded in the Hey and Embley Rivers or during targeted August 2012 survey. However, this species are known to occur in estuarine and coastal habitats. As such, it is likely that this species may occur in the ferry/barge terminals. **Balance of Project Area not disturbed** **Known to Occur**: Incidental sightings of this species were recorded in coastal waters during field studies. **Shipping Routes** **Known to Occur**: Although the Australian Snubfin Dolphin has been recorded from the Gladstone area and throughout coastal waters along the north Queensland coast, the species would generally occur inshore and in shallower waters rather than the majority of the shipping route.

Table 9-12 Profile Summary – Indo-Pacific Humpback Dolphin

Species	Habitat Preferences			Known / estimated population	Likelihood of Occurrence
	Foraging	**Breeding**	**Migratory**		
Indo-Pacific Humpback Dolphin (*Sousa chinensis*) (Migratory)	Mangroves to sandy bottom estuaries and embankments to rock and/or coral reefs.	Unknown. No calving areas are known in Australian waters.	Unknown. There is some evidence of longshore movements of animals in Australian populations.	Unknown. Regional population levels (e.g. Queensland) are likely to be in the order of thousands rather than tens of thousands.	**Proposed Port Site** **Known to Occur**: Incidental sightings of this species were recorded in the vicinity of the proposed Port footprint during field studies. Targeted cetacean surveys in 2012 confirmed the presence of Indo-Pacific Humpback Dolphins at Boyd Point. **Proposed New Spoil Ground** **Possible**: No incidental sightings were recorded. This species usually inhabits shallow coastal waters less than 20m deep. The proposed new spoil ground is in deeper water than this and therefore it is unlikely to represent preferred habitat for this species. However, it is possible they may migrate through the area. **Albatross Bay Spoil Ground** **Possible**: No incidental sightings were recorded. The Albatross Bay spoil ground is primarily characterised as flat, unvegetated soft sediments habitat, and is therefore unlikely to support sufficient densities of prey species to be considered preferred habitat for this species. However, it is possible that this species may migrate through or opportunistically feed in the area. **Ferry/Barge Terminals – Hey and Embley Rivers** **Known to Occur**: Targeted cetacean surveys in 2012 confirmed the presence of Indo-Pacific Humpback Dolphins within the Embley River estuary. **Balance of Project Area not disturbed** **Known to Occur**: Incidental sightings of this species were recorded in coastal waters during field studies. **Shipping Routes** **Known to Occur**: Although the species has been recorded from the Gladstone area and throughout coastal waters along the north Queensland coast, the Indo-Pacific Dolphin would generally occur inshore and in shallower waters rather than the majority of the shipping route.

Table 9-13 Profile Summary – Bryde's Whale

Species	Habitat Preferences			Known / estimated population	Likelihood of Occurrence
	Foraging	**Breeding**	**Migratory**		
Bryde's Whale (*Balaenoptera edeni*) (Migratory)	Inshore form moves along the coast inside the 200m depth contour in response to prey availability. Offshore form is found in waters 500-1,000m deep.	Limited data suggest breeding and calving in lower latitudes.	No evidence of large-scale movements of inshore form. Offshore form may migrate to warmer tropical waters during winter.	Unknown. Inshore stocks likely to be small, and total Australian population estimated at less than 10,000 mature animals.	**Proposed Port Site** **Possible**: While the proposed Port site does not contain preferred habitat, the recording of the species from tropical inshore waters suggests it is possible that the species may occur sporadically in the vicinity of the proposed Port footprint. **Proposed New Spoil Ground** **Possible**: This species may possibly occur within the proposed new spoil ground footprint for the same reasons that it possibly occurs in the vicinity of the proposed Port site. **Albatross Bay Spoil Ground** **Possible**: This species may possibly occur within the Albatross Bay spoil ground footprint for the same reasons that it possibly occurs in the vicinity of the proposed Port site. **Ferry/Barge Terminals – Hey and Embley Rivers** **Unlikely**: Although this species occurs in shallow water, it generally is found in coastal areas rather than estuaries. It is therefore unlikely to occur within the barge/ferry terminal footprints in the Embley and Hey Rivers. **Balance of Project Area not disturbed** **Possible**: While the Project area does not contain preferred habitat, it is possible that the species may occur sporadically in the Project area. **Shipping Routes** **Possible**: Although there have been very limited confirmed sightings of the Bryde's Whale in Australia, the majority of the shipping route is within suitable pelagic habitat and the known geographic range for this species.



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Rio Tinto Alcan

RTA mining lease boundary
Locality
Roads/track
River
Freshwater dam
Tailings storage facility

Habitat
Potential foraging habitat (0-20m deep)

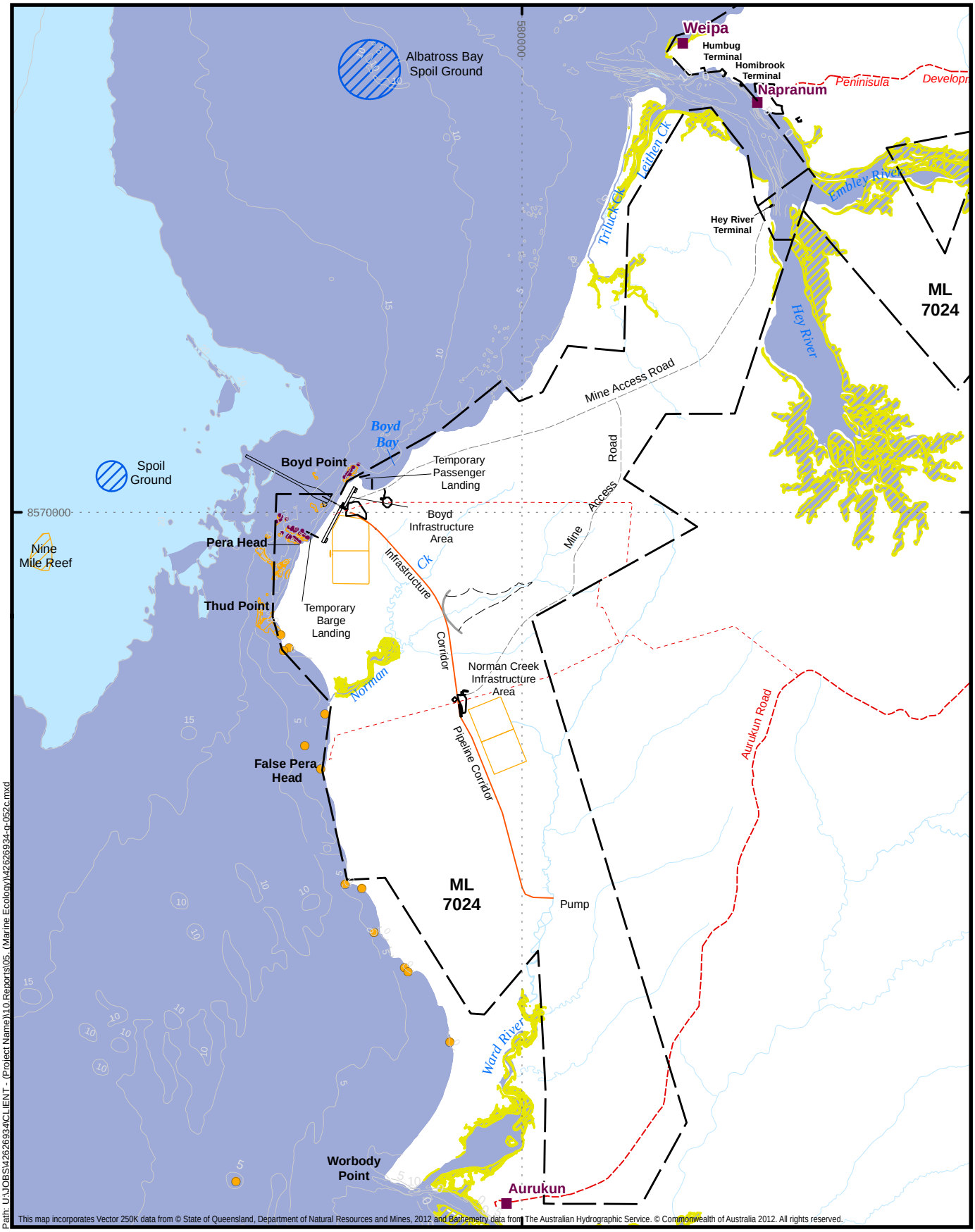
South of Embley Project

Fig. 9-8: Potential Habitat of Australian Snubfin Dolphin (Project Area)

N

0 2.25 4.5 9 km

Datum/Projection: GDA94/MGA Zone 54 Date: 06/11/2012



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Rio Tinto Alcan

- RTA mining lease boundary
- Locality
- Roads/track
- River
- Freshwater dam
- Tailings storage facility

Note: Video transect conducted in February 2012 identified reef substrate supporting hard coral near Boyd Point.

Habitat
- Potential foraging habitat (0-20m deep)
- Potential mangrove foraging habitat

Reefal Habitat
- Potential reefal foraging habitat
- Unconfirmed reef locations
- Live coral cover (hard coral and/or soft coral/sponges)

South of Embley Project

Fig. 9-9: Potential Habitat of Indo-pacific Humpback Dolphin (Project Area)

N

0 2.25 4.5 9 km

Datum/Projection: GDA94/MGA Zone 54 Date: 06/11/2012

9.5.4 Relevant Impacts on Cetaceans

Potential unmitigated impacts on cetaceans during the construction and operational stages of the Project may result from dredging and offshore spoil disposal, construction and operation of the marine and river facilities, and Project-related shipping activities.

The following sections outline the potential relevant direct impacts on cetaceans during the construction and operational stages of the Project. No indirect impacts on cetaceans related to the Project have been identified. **Table 9-14** provides a summary of the relevant impacts to cetaceans from Project construction and operational activities and provides cross references to the sections where they are described.

Table 9-14 Cross References to Impacts on Cetaceans

	CONSTRUCTION ACTIVITIES			OPERATIONAL ACTIVITIES		
POTENTIAL IMPACT PRIOR TO MITIGATIONS	**Dredging and offshore spoil disposal**	**Marine and river facilities**	**Shipping**	**Dredging and offshore spoil disposal**	**Marine and river facilities**	**Shipping**
DIRECT IMPACTS						
Physical disturbance to benthic or intertidal habitats from dredging	**9.5.4.1**			**9.5.4.1**		
Creation of turbidity plume	**9.5.4.1**			**9.5.4.1**		
Deposition of dredged sediments on benthic habitat	**9.5.4.1**			**9.5.4.1**		
Entrainment in dredge	**9.5.4.1**			**9.5.4.1**		
Underwater acoustic impacts from pile driving and vessel movements		**9.5.4.2**	**9.5.4.3**		**9.5.4.2**	**9.5.4.3**
Marine oil spill			**9.5.4.3**			**9.5.4.3**
Vessel strike			**9.5.4.3**			**9.5.4.3**

9.5.4.1 Dredging and Offshore Spoil Disposal

The pressure analysis outlined in The Species Group Report Card – Cetaceans: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012l) determined that "physical habitat modification resulting from onshore construction" was of concern for dolphins. Specifically, DSEWPaC (2012l) states:

> "*Habitat modification* (associated with construction and dredging activities) *from coastal development is considered one of the greatest threats to inshore dolphins"*

Directly related to this pressure is dredging and dredge spoil disposal which is assessed by DSEWPaC 2012l as of potential concern to dolphins.

A description of capital and maintenance dredging and offshore disposal activities is provided in **Section 9.3.4.1.** The potential direct impacts associated with dredging and offshore spoil disposal on cetaceans include:

- physical disturbance to benthic or intertidal habitats from dredging;
- creation of turbidity plume;
- deposition of dredged sediments on benthic habitat; and,
- entrainment in dredge.

These potential impacts are discussed in detail below.

Physical disturbance to benthic or intertidal habitats from dredging

As discussed in **Section 9.3.4.1**, during capital dredging, benthic habitats in the dredge footprint of the Port and river facilities would be completely removed until such time as they recolonise (although re-colonisation may be limited by subsequent maintenance dredging during the operational phase of the Project). The proposed dredging activities within the Hey and Embley Rivers are predicted to result in a negligible impact on prey fish and crustaceans, nor habitat essential for Australian Snubfin and Indo-Pacific Humpback Dolphin. For the Australian Snubfin Dolphin, the total area of disturbance to potential foraging habitat by proposed infrastructure, dredging and offshore disposal grounds is estimated to be 14.9km^2 of soft sediment. The disturbance area represents 0.8% of the potential foraging habitat within the Project area and a negligible proportion of the potential habitat out to 20m depth (refer **Section 9.5.1.1**).

For the Indo-Pacific Humpback Dolphin, the total area of disturbance to potential foraging habitat by the proposed infrastructure, dredging and offshore disposal grounds has been calculated to be 14.9km^2 for soft sediment, 400m^2 for mangrove, and 1,290m^2 for reefal habitat. The disturbance area represents less than 0.7% of the potential foraging habitat within the Project area and a negligible proportion of the potential habitat out to 20m depth (refer **Section 9.5.1.2**).

The dredge footprint of the Project area is primarily characterised as flat, unvegetated soft sediments habitat, and are therefore unlikely to support high densities of prey species to be considered important foraging habitat for the Bryde's Whale. Bryde's Whales are opportunistic feeders and, if present, are considered likely to be only transitory through the Project area.

Based on the above assessment, it is anticipated that the potential unmitigated impact on all three of the cetacean species from physical disturbance to benthic or intertidal habitats associated with capital dredging activities would be negligible and short term. Maintenance dredging at the proposed Port would continue throughout the duration of the Project so impacts would be negligible and long term.

Creation of turbidity plume

As discussed in **Section 9.3.4.1**, all dredge material is suitable for unconfined ocean disposal and does not contain any constituents present at contaminant levels of environmental concern (**Appendix 7-B**).

The creation of turbidity plumes associated with dredging activities and offshore spoil disposal may impact cetacean foraging habitat by increasing sedimentation.

Water quality at the proposed Port, proposed new spoil ground, and ferry and barge terminals exhibits significant natural fluctuations in suspended sediment (reflected in the turbidity measurements). These areas experience naturally high turbidity and sedimentation rates over extended periods of time. It is considered that the creation of turbidity plumes by dredging activities and offshore spoil

disposal are likely to be less significant than turbidity produced by storms in the area that the Australian Snubfin and Indo-Pacific Humpback Dolphins would normally swim in.

A previous study (GHD 2005) has assessed the impacts of turbidity generated by dredging operations in the Port of Weipa. The study examined impacts from a dredging campaign involving a much larger volume (greater than 3,000,000m^3) of maintenance and capital material. It concluded that changes in water quality in sensitive areas from migration of material would be negligible because plumes are predicted to migrate south towards the South Channel.

The migration and dispersion of turbid plumes during capital dredging and disposal at the proposed new spoil ground has been predicted through modelling (refer **Appendix 7-A**). Modelling results identified a median Total Suspended Solids concentration of approximately 2mg/L above background. The plumes at the proposed new spoil ground are predicted to disperse along a south south-easterly trajectory due to tidal currents and would not reach Nine Mile Reef, which is located approximately 6km southwest of the proposed new spoil ground. The modelling predicted that 80th percentile Total Suspended Solids concentrations outside the immediate vicinity of the proposed new spoil ground would be only 2 to 3mg/L above background.

Turbidity plumes from dredging are predicted to reach sponge and coral habitats from Boyd Point to Pera Head, and further south towards Thud Point. Reefs in this area are predicted to be sediment tolerant, experiencing naturally high turbidity and sedimentation rates over extended periods of time. Therefore the impact of sediment plumes and sedimentation from capital dredging on cetaceans foraging habitat is expected to be minor to negligible. In addition, alternative foraging habitat for cetacean species, which is similar to the area that may be affected, occurs between Pera Head and Thud Point, and at inshore reef areas south of Thud Point, and north of Boyd Point extending to Albatross Bay.

While Bryde's Whales may move through the Project area when periodically migrating between foraging areas, the creation of a turbidity plume would not represent a barrier to migration that is likely to result in any meaningful impact on Bryde's Whales in the region.

Based on the above assessment, the potential unmitigated impact on all three cetacean species from the creation of turbidity plumes during capital and maintenance dredging activities and offshore spoil disposal would be negligible and would only eventuate during dredging campaigns so would be short term.

Deposition of dredged sediments on benthic habitat

The deposition of dredged sediments on benthic habitats may impact cetacean species by smothering foraging habitat.

The proposed new spoil ground is too deep to be preferred foraging habitat for the Australian Snubfin Dolphin and Indo-Pacific Humpback Dolphin. The proposed new spoil ground and Albatross Bay spoil ground are both characterised as flat, unvegetated soft sediments habitat, and are therefore unlikely to support high densities of prey species to be considered important foraging habitat for the Bryde's Whale. Bryde's Whales are opportunistic feeders and, if present, are considered likely to be only transitory through the Project area.

Based on the above assessment, it is anticipated that the potential unmitigated impact on all three cetacean species from deposition of dredged sediments on benthic habitats associated with capital dredging activities would be negligible and short term, but would continue throughout the duration of the Project for maintenance dredging, so would be negligible and long term.

Entrainment in dredge

As discussed in **Section 9.3.4.1**, dredging activities using a TSHD may injure or kill individual cetaceans as a result of accidental intake and entrainment as the trailing dredge head moves along the seabed. The use of fauna exclusion devices on the TSHD dredge heads would minimise the potential for entrainment of cetaceans. Entrainment by CSDs is less likely due to the slow rate of area covered by dredging and barge-mounted backhoe/dipper dredger would not pose an entrainment hazard to cetaceans.

Due to their high mobility and manoeuvrability, Australian Snubfin and Indo-Pacific Humpback Dolphins are not at risk of entrainment in dredging equipment, which would be slow moving and highly audible to these animals. The size of the Bryde's Whale means it is not at risk from entrainment in dredge equipment.

Based on the above assessment, the potential unmitigated impacts on these cetacean species from entrainment due to capital and maintenance dredging activities would be negligible and would only eventuate during dredging campaigns, so would be short term.

9.5.4.2 Marine and River Facilities Construction and Operations

Pressure analysis outlined in The Species Group Report Card – Cetaceans: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012l) determined that "noise pollution" resulting from onshore and offshore construction (among other things) was of potential concern to dolphins.

Underwater noise during construction would be principally generated by pile driving activities at both the marine and river facilities. The numbers and positions of piles proposed for the Project are provided in **Section 3.6.2** and underwater noise associated with the Project is discussed in detail in **Section 15.3.2** and **Appendix 15-A**.

Construction works for the Humbug terminal would include floating pontoons and ramps as well as mooring dolphins. An area of about 400m^2 may be reclaimed behind a sheet pile wall or alternatively a concrete abutment supported by piles would be constructed. Construction works for the combined Hornibrook terminal and Tug Berths would include piling for pontoon's for each facility and with a floating ramp common to both facilities. The Hey River terminal would include construction of floating pontoons and ramps. An area of approximately 4,400m^2 would be reclaimed and supported by rock revetment and/or sheet piles, or a concrete abutment may be constructed. Temporary seaborne access, including a beach landing ramp for barges and small boats and a passenger jetty, may also be required during the construction phase of the Project (**Section 3.6.5**).

Cetaceans are potentially sensitive to underwater noise, and construction activities such as piling activities have the potential to temporarily alienate cetaceans from the area, cause physical damage to the auditory system or cause temporary changes in behavioural patterns (Tyack 2008). Underwater noise level criteria have been developed for cetaceans by Southall *et al*. (2007) to determine noise levels at which animals would experience behavioural impacts or physical injury (refer **Section 15.3.2.2**).

Modelling concluded that injury to the Bryde's Whale would only potentially occur immediately adjacent (approximately within 31m) to piling activities for the largest pipe piles (1,500mm diameter) at the proposed Port. For the smaller pipe piles, vibratory driving and drilling at the other facilities the distance within which injury impacts to the Bryde's Whale may occur would be less. Piling activities may be loud enough to cause injury to the Australian Snubfin Dolphin and Indo-Pacific Humpback Dolphin, however the distance would be less than predicted for the Bryde's whale at all facilities, for all pile sizes and types.

Modelling concluded that for the Bryde's whale at the Port, ecologically meaningful behaviour disturbance may occur up to 1,330m from the largest 1,500mm piles. Potential behaviour disturbance distances from smaller piles would be less (see **Table 15-6**). The Bryde's whale may be disturbed up to 1,580m at the Port for a scenario where three piling rigs are operating simultaneously (one rig piling a 1,500mm pile and two rigs piling 1,050mm piles). This is the largest potential behaviour disturbance if three piling rigs are utilised, however impacts would likely be less if three rigs or two rigs were operating on a different combination of piles (see **Table 15-6**). The disturbance area does not contain important foraging habitat for the Bryde's Whale. Bryde's Whales are opportunistic feeders and, if present, are considered likely to be only transitory through the Project area. The Bryde's Whale is generally found further offshore and therefore is unlikely to be impacted by piling activities within the Embley and Hey Rivers.

Potential distances of ecologically meaningful behaviour disturbance for the Australian Snubfin Dolphin and Indo-Pacific Humpback Dolphin from piling activities (pipe piles) are presented below for the largest piles at each facility (see **Table 15-2**). Potential distances of ecologically meaningful behaviour disturbance from smaller piles would be less and are shown in the tables indicated below for each facility. Potential distance of ecologically meaningful behaviour disturbance would be 400m from the Port for the 1,500mm pile (see **Table 15-6**), 380m from the Hey River terminal for the 1,050mm pile (see **Table 15-9**), 280m from the 1,050mm piles at the navigation aids to be installed in the Embley and Hey Rivers (see **Table 15-10**), 250m from the Hornibrook terminal for the 1,050mm piles (see **Table 15-8**) and 160m from the Humbug terminal for the 900mm piles (see **Table 15-7**). Dolphins may be disturbed up to 500m at the Port for a scenario where three piling rigs are operating simultaneously (one rig piling a 1,500mm pile and two rigs piling 1,050mm piles) (see **Table 15-6**). This is the largest potential disturbance distance if three piling rigs are utilised, however impacts would likely be less if three rigs were operating on a different combination of piles or less than three rigs were operating simultaneously.

Drilling activities at the Port may cause ecologically meaningful behavioural disturbance of the Bryde's whale, however potential disturbance distance was predicted to be within 30m (see **Table 15-6**). Ecologically meaningful behavioural disturbance to both dolphin species from drilling activities would be unlikely at all facilities. Vibratory piling (sheet piles) activities at Humbug and Hey River terminals may cause ecologically meaningful behaviour disturbance to Australian Snubfin and Indo-pacific Humpback Dolphins, however potential disturbance distances are predicted to be less than 10m at both facilities (see **Table 15-7** and **Table 15-9**). Vibratory piling would also be used at the temporary seaborne access facilities near Pera Head and Boyd Point/Boyd Bay. Potential behaviour disturbance distances from these facilities were not modelled. However, the lower impact of this method compared to piling driving and the limited duration of acoustic impact in the vicinity of the temporary seaborne access, given the small number of piles that would be installed at each facility (eight at the temporary barge landing area and between 16 and 32 at the temporary passenger jetty), would mitigate the potential impact on cetaceans in this area.

The Project area is not considered to represent a significant proportion of the population for these cetacean species. No impact on the life cycle of these species is therefore expected as a result of underwater noise associated with pile driving during the construction works. It is also considered unlikely that underwater noise from piling activities would present a barrier to movement of these cetacean species as there is large coastal area for transit, and area to avoid underwater noise from pile driving activities.

While it is possible pile driving activities may temporarily displace the Bryde's Whale, Australian Snubfin Dolphin and Indo-Pacific Humpback Dolphin, the proportion of potential habitat that would be impacted is negligible and pile driving activities would be of short-term duration. Therefore, based on the above assessment, the potential unmitigated impacts on cetacean species from underwater noise during pile driving activities would be minor and short term.

9.5.4.3 Project-related Shipping

It is noted that DSEWPaC's *Significant Impact Guidelines* (DEWHA 2009c) states that, where appropriate precautions have been taken against translocating potential pest species (refer **Section 4.5.3.14** for information relating to measures for mitigating risks associated with pest introductions from shipping), routine ship transits would not normally be expected to have a significant impact on a matter of NES. However an assessment of Project-related shipping activities on cetaceans has been made in accordance with the Tailored EIS Guidelines.

Project-related shipping activities have the potential to impact on cetacean species and their habitat. The potential direct impacts include:

- underwater acoustic impacts from vessel movement;
- marine oil spill; and,
- vessel strike.

These potential impacts are discussed in detail below.

Underwater acoustic impacts from vessel movement

Pressure analysis outlined in The Species Group Report Card – Cetaceans: Supporting the Marine Bioregional Plan for the North Marine Region (DSEWPaC 2012l) determined that "noise pollution" resulting from shipping vessels (among other things) was of potential concern to dolphins.

Marine mammals use sound for many reasons such as communication, navigation, predator avoidance and prey capture (Marine Mammal Commission 2007, McCauley and Cato 2003). It is suspected that changes in the local marine acoustic environment due to shipping noise have the potential to elevate ambient noise levels and mask communication signals and impact on biology and behaviour of marine species. The range of dolphin vocalisations is at higher frequencies (0.2 to 150kHz) than whales, and is mostly outside the primary range of shipping noise. However, dolphin species may experience masking of communication when vessels are in close proximity (Okeanos 2008). Nevertheless dolphins commonly ride the bow waves of ships at sea and dolphin species are commonly present in port areas, suggesting they are not disturbed by underwater sound from vessels. In addition, Australian Snubfin and Indo-Pacific Humpback Dolphins that may utilise the Project area are not identified as representing a significant proportion of the population of their respective species and breeding is not known to occur in the Project area.

The predicted increase in Project-related shipping through the CMA is minor and the shipping movements through the Gulf of Carpentaria would remain at relatively low levels (refer **Section 10.3.5**). There is only a small predicted increase in Project-related shipping through the GBR compared to existing levels (refer **Section 11.3.4**). It is anticipated that Project-related shipping would not significantly alter the behavioural response of cetacean species or represent a barrier to migration that is likely to result in any meaningful impact to populations in the region.

It is not anticipated that the Project area contains important foraging habitat for the Bryde's Whale which are considered to be only transitory through the Project area. Therefore Project-related shipping activities are unlikely to exclude this species from important habitat or present a barrier to migration.

Overall, it is considered that unmitigated underwater acoustic noise on cetacean species from Project-related shipping activities during construction would be negligible and short term and during operations would be negligible and long term as the impact would be present for the duration of the Project.

Marine oil spill

The threat and likelihood of impacts from marine oil spills associated with Project-related shipping activities, including the results of stochastic oil spill modelling, are discussed in **Sections 4.5.3.4** and **4.5.3.5**. The impact of marine oil spills in the CMA and GBRMP are also assessed in **Sections 10.4.6** and **11.4.6**.

Marine oil spills have the potential to significantly impact on cetacean species if they are directly exposed. Cetacean species may be directly harmed by surface oil and hydrocarbon vapours when they surface to breath. In Australia, the greatest risk of oil spills, in terms of both frequency and costs, relates to incidents occurring in ports via fuel and oil transfer spills (for spills exceeding 1t in volume) (DNV 2011). However, collisions of Project vessels with other vessels, stationary objects such as port structures and grounding on benthic substrates have the potential to cause marine oil spills of a greater volume as a result of damage to fuel tanks in the vessel's hull (refer **Section 4.5.3.3**).

Total predicted bauxite shipping (600 movements per annum at maximum production) equates to approximately 4.0% of the long term shipping forecast in the inner GBR Designated Shipping Area. The predicted additional bauxite shipping would represent approximately 0.4% of the GBRMPA (2012b) long term shipping forecast in the inner GBR for 2020. However, in 40 years of bauxite shipping from Weipa to Gladstone, there has been no reported collision or grounding incidents that have resulted in environmental harm. Project-related shipping (including the small increase at maximum production) is therefore not likely to increase the risk of collision or grounding and therefore a marine oil spill.

Stochastic spill modelling results outlined in **Appendix 4-D** of a 25.25m^3 spill suggested that there would be up to 2% and up to 6% possibility of 0.01mm or thicker water-surface slicks entering the GBRMP from a spill at Fisherman's Landing and South Trees Wharf respectively if such a spill occurred. For the modelled cells within the GBRMP that have a possibility for oil on water, there is a maximum probability of 2% and 6% for a slick to occur from a spill at Fisherman's Landing and South Trees Wharf respectively. The model results for a 5t spill at both Fisherman's Landing and South Trees Wharf would not result in any water-surface oil slicks of 0.01mm or thicker being transported into the GBRMP. Based on the DNV (2011) estimate of the annual probability of a spill (> 10t) in the GBRMP being 0.0511 and the probability of an oil spill greater than 10t from a Project-related vessel (bauxite or cargo) traversing the GBR is 0.0174 (1.74%), and therefore the increase in the annual probability of a spill due to the predicted increase in Project-related shipping is estimated to be 0.0058 (or 0.58%). Given a similar increase in spill probability in the Port of Gladstone, the small potential increase in Project-related shipping at maximum production would only increase the risk of an oil or fuel spill entering the GBRMP to a negligible extent. It should be noted the modelling is based on a spill without any control measures. When operating in Australia, the Project-related bauxite ships would only take on bunker fuel at Gladstone, working under the existing controls and procedures of the Gladstone Ports Corporation. There would be no bunkering of bulk carriers at the proposed Port facilities.

The constraints on vessel speeds in the proposed Port and construction areas as well as the Port of Gladstone and the management initiatives that have been implemented along the shipping routes such as recommended pilotage regimes, means that the risk of a marine oil spill occurring due to collision or grounding is considered to be unlikely. The deeper water through the majority of the

shipping routes also makes grounding of vessels unlikely. While the probability of a marine oil spill occurring is unlikely, such an incident would result in serious injury or mortality to cetacean species in the vicinity of the spill. Therefore, although the risk is unlikely, the potential unmitigated impact of a marine oil spill from Project-related shipping activities on cetaceans throughout the life of the Project would be minor and short term.

Vessel strike

Project-related shipping activities are discussed in **Section 4.5.3.13** and the impact of vessel strikes in the CMA and GBRMP are assessed in detail in **Sections 10.4.3** and **11.4.2**.

Cetacean species migrating through the Project area and shipping routes may be vulnerable to collision with Project-related vessels. The International Whaling Commission (IWC) maintains a database of vessel strikes on whales. The IWC database lists a total of 38 reported vessel strikes of whale species in Australia between 1988 and 2009. Based on the descriptions of the 11 reported strikes which occurred within the GBRWHA boundary during these years, nine could be attributed to faster moving recreational, tourism vessels or other vessels less than 50ft in length. The remaining two strikes list the vessel type as unknown and a large commercial vessel. Conservatively assuming the unknown vessel strike was a large commercial vessel, there were two strikes in 21 years between 1988 and 2009, which equates to approximately 0.095 whale strikes per annum from large commercial vessels in the GBRWHA. The QPWS stranding database annual reports recorded one Bryde's Whale, 25 Australian Snubfin Dolphins and seven Indo-Pacific Humpback Dolphins being struck in the GBR, or found within the area with vessel strike injuries between 1996 and 2010. Based on the proportion of cetacean deaths from vessel strike in Queensland reported to QPWS, the average mortality in Western Cape waters from vessel strike was calculated at 0.01 per annum over the period 2000 to 2007.

The potential for vessel strike on Australian Snubfin and Indo-Pacific Humpback Dolphins would be less than for the Bryde's Whale due to their greater mobility and ability to quickly respond to disturbances. Large vessels operating in the proposed Port area and Embley and Hey Rivers do not pose a risk to either dolphin species because of their high manoeuvrability.

The Project involves operating a ferry between the Hornibrook and Hey River terminals and a barge between the Humbug terminal and the Hey River terminal. Predictable vessel movements such as from a ferry crossing a river on a set course result in substantially less impact on dolphin behaviour, and impacts that may occur are not necessarily ecologically meaningful (Constantine *et al*. 2004, Lusseau *et al*. 2006, Piwetz *et al*. 2012). However, transit lanes would be defined to reduce the overall area of disturbance from vessel activities and the vessels would slow in shallower water as it approaches berth. Transit lanes would also follow the greatest water depths and avoid significant meadows of seagrass beds (refer **Figure 4-3** to **Figure 4-7**) unless directed otherwise by the Regional Harbour Master. The barge and ferry that would operate in the Embley and Hey Rivers would present a slightly greater risk of vessel strike to Australian Snubfin and Indo-Pacific Humpback Dolphins as a result of its higher operating speeds, but the risk of a vessel strike on these species in the Embley and Hey Rivers is still considered to be unlikely.

The Bryde's Whale is less mobile, and therefore more vulnerable to vessel strike, although this whale is only likely to occur further offshore so inshore vessels, including barges and dredges, are unlikely to pose a threat to this species. Bryde's Whales are at greater risk from vessel strike during the offshore transit by large vessels coming from outside the area to supply materials for the Project or in shipping routes.

In the operational phase of the Project bulk carriers would be used for bauxite transport. Bulk carriers are large and slow moving (14 knots being the usual cruising speed) and would be travelling more slowly and under pilotage in shallow or confined marine areas where the Australian Snubfin Dolphin and Indo-Pacific Humpback Dolphin are more commonly found. Bauxite has been shipped from the Port of Weipa to the Port of Gladstone via the inner GBR Designated Shipping Area for over 40 years and there have been no reported incidents of vessel strike on marine fauna by these vessels. Based on the predicted increase in vessel movements in the Project area and historic reported rates of vessel strike in the Western Cape York (QPWS Wildlife stranding database annual reports), it is estimated that mortality of cetaceans as a result of vessel strike could increase by less than one per annum. Although it is noted that not all vessel strikes are reported, this estimated increase does not take into account that the majority of the potential increased vessel numbers pose a lower risk of vessel strike due to their size and speed. Therefore, Project-related bauxite shipping (including the small predicted increase at maximum production) is not considered to significantly increase the risk of vessel strike on cetacean species.

The potential unmitigated impact on cetacean species from vessel strike associated with Project-related shipping activities during construction would be negligible and short term, and negligible and long term during operations as the risk would be present for the duration of the Project.

9.5.5 Avoidance, Mitigation, Enhancement Measures and Residual Impacts

The following sections outline the specific avoidance, mitigation and enhancement measures that would be implemented to reduce the potential impacts on cetacean species associated with dredging and offshore spoil disposal, construction and operation of marine and river facilities, and Project-related shipping activities (described in **Section 9.5.4**).

An environmental management plan outline for cetaceans that summarises these avoidance, mitigation and enhancement measures is provided in **Appendix 9-A**.

9.5.5.1 Dredging and Offshore Spoil Disposal

Draft DMP's for the proposed Port and river facilities have been prepared (refer **Appendix 7-C** and **Appendix 7-D**). The draft DMPs propose mitigation and monitoring measures for dredging and offshore spoil disposal activities. The mitigation and monitoring measures that would be implemented will be in accordance with the final DMP's, which will be approved by DSEWPaC and EHP.

Physical disturbance to benthic or intertidal habitats from dredging

Negligible impacts on cetacean species are anticipated as a result of physical disturbance to benthic or intertidal habitats associated with dredging activities and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on cetacean species from physical disturbances to benthic or intertidal habitats associated with dredging activities are the same as those detailed in **Section 9.3.5.1** for Estuarine Crocodiles.

Creation of turbidity plume

Negligible impacts on cetaceans are anticipated as a result of the creation of a turbidity plume associated with dredging and offshore spoil disposal activities and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on cetacean species from the creation of a turbidity plume during dredging and offshore spoil disposal activities are the same as those detailed in **Section 9.4.5.1** for Dugongs.

Deposition of dredged sediments on benthic habitat

Negligible impacts on cetaceans are anticipated as a result of the deposition of dredged sediments on benthic habitat associated with dredging and offshore spoil disposal activities and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on cetacean species from the deposition of dredged sediment on benthic habitat are the same as those detailed in **Section 9.4.5.1** for Dugongs.

Entrainment in dredge

Negligible impacts on cetacean species are anticipated as a result of entrainment in dredge equipment and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on cetacean species from entrainment in dredge equipment are the same as those detailed in **Section 9.3.5.1** and **9.4.5.1** for Estuarine Crocodiles and Dugongs.

9.5.5.2 Marine and River Facilities Construction and Operations

Underwater acoustic impacts from pile driving

The mitigation measures to reduce the unmitigated impacts on cetacean species related to underwater noise from pile driving which have been derived from the assessment outlined in Section **15.3.3.1** are summarised as follows.

- for marine and river pile driving activities, the soft start approach would be used to disperse marine and migratory fauna (including marine turtles) prior to normal pile driving activities commencing;
- continual marine fauna observations (including cetaceans) would be conducted for 30 minutes prior to and during marine and river pile driving activities;
- observation zones would be maintained over the distances shown in **Tables 15-6** to **Table 15-10** with a minimum observation distance of 300m maintained at all times;
- The observation zone for the likely worst case scenario (1 x 1,500mm and 2 x 1,050mm pipe piles at the Port) would be the largest zone required if three piling rigs are utilised. If a different combination is used which may result in a lower impact an appropriate observation zone may be determined in consultation with DSEWPaC;
- marine and river pile driving activities would be stopped if cetaceans enter within an exclusion zone of 100m and remain within the zone for greater than five minutes;
- no piling activities would commence if cetaceans are observed within the exclusion zone during visual observations prior to start-up; and,
- all equipment and machinery would be maintained in accordance with manufacturer's recommendations and excessive underwater noise would be investigated and remedied.

With the implementation of these mitigation measures residual impacts to cetacean species from underwater noise associated with pile driving activities would be negligible and short term.

9.5.5.3 Project-related Shipping

Underwater acoustic impacts from vessel movement

Negligible impacts on cetacean species are anticipated as a result of underwater noise impacts associated with Project-related shipping activities and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on cetacean species associated with underwater noise from Project-related shipping activities are the same as those detailed in **Section 9.4.5.3** for Dugongs.

Marine oil spill

The mitigation measures to reduce the unmitigated impacts on cetacean species from a marine oil spill associated with Project-related shipping activities are detailed in **Section 9.4.5.3** for Dugongs. Although these measures reduce the risk of a marine oil spill occurring to unlikely, any incident may result in injury or mortality of an individual animal if they are exposed. Therefore, although the risk is unlikely, the residual impact of a marine oil spill from Project-related shipping activities throughout the life of the Project would remain minor and short term.

Vessel strike

Negligible impacts on cetacean species are anticipated as a result of vessel strike associated with Project-related shipping activities and therefore no specific mitigation is warranted. However, mitigation measures to further reduce the impacts on cetacean species from vessel strike associated with Project-related shipping activities are the same as those detailed in **Section 9.4.5.3** for Dugongs.

9.5.5.4 Summary of Residual Impacts on Cetaceans Following Mitigation

Table 9-15 summarises the potential unmitigated construction and operational impacts that are minor or greater, the relevant mitigation measures to be implemented and the resulting residual impacts on cetacean species.

Table 9-16 summarises the potential impacts on cetaceans resulting from the Project considering proposed mitigation measures and in relation to the significant impact criteria for matters of NES (DEWHA 2009c).

9.5.5.5 National Recovery Plans and Threat Abatement Plans

There are currently no national recovery plans for the Australian Snubfin Dolphin, Indo-Pacific Humpback Dolphin or Bryde's Whale. The *Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life* (DEWHA 2009d) is listed on the SPRAT database as being relevant for the Australian Snubfin Dolphin (DSEWPaC 2012q). **Table 9-10** which outlines the consistency of the Project with this threat abatement plan for the Dugong is the same as for the Australian Snubfin Dolphin.

9.5.6 Offsets

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012b), offsets are not required where the residual impact is not likely to be significant (when assessed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009c)).

Section 9.5.4 and **Section 9.5.5** of this report documents the results of the impact assessment process and concludes that with the implementation of the proposed mitigation measures, the residual impacts associated with construction and operation of the Project on cetaceans would be negligible to minor and therefore not significant (refer **Section 9.1.2**). As such, offsets relating to cetaceans are not required under the Commonwealth offsets policy.

Table 9-15 Summary of Potential Impacts, Mitigation and Enhancement Measures, and Residual Impacts on Cetaceans

Potential Impact	Unmitigated Impact Magnitude		Relevant Mitigation and Enhancement Measures	Residual Impact Magnitude	
	Construction	Operation		Construction	Operation
Underwater acoustic impacts from pile driving and vessel movements	Minor and short term (Pile driving) and negligible and short term (Project-related shipping).	Negligible and long term (Project-related shipping).	Marine fauna observations. Soft-start procedures for marine piling operations. Equipment maintenance to minimise noise. Vibratory hydraulic hammer for temporary seaborne access.	Negligible and short term (Pile driving, Project-related shipping).	Negligible and long term (Project-related shipping).
Marine oil spill	Minor and short term.	Minor and short term.	Oil spill risk reduced by operational controls to minimise the risk of collisions or grounding as well as vessel maintenance. Oil spill contingency planning and equipment to minimise the amount of oil spilled and facilitate rapid response. No oil discharges in accordance with MARPOL	Minor and short term.	Minor and short term.

Table 9-16 Impact Assessment Summary - Indo-Pacific Humpback Dolphin, Australian Snubfin Dolphin and Bryde's Whale

Will the proposed works…	**Indo-Pacific Humpback Dolphin (*Sousa chinensis*), Australian Snubfin Dolphin (*Orcaella heinsohni*) and Bryde's Whale (*Balaenoptera edeni*): Migratory**
… substantially modify, destroy or isolate an area of important habitat for a migratory species;	Cetaceans may be impacted by: disturbance from boating and shipping activities including alienation from habitat, acoustic impacts, vessel strike and creation of an offshore turbidity plume during dredging. However, potential impacts would generally be limited to inshore areas, rather than the deeper, open ocean environments along the shipping route. Project-related shipping activities would not modify, destroy or isolate areas of important habitat for cetacean species. The construction of the wharf for the Port would involve pile driving. The underwater noise generated by the hammer hitting the top of the pile would be of short term duration and therefore can be described as impulsive noise. The time taken to drive each pile would depend on the hardness of the seabed in each location. There is potential for marine animals in an area close to the piling to incur hearing damage as a result of the piling. It is anticipated construction activities would deter most marine mammals from the immediate area, however for precautionary purposes, it is proposed that a "soft-start" approach would be used to disperse animals in the vicinity prior to normal pile driving. The "soft-start" involves commencing pile driving with a partial capacity strike, or giving a warning with an underwater airgun prior to normal pile driving. Construction of the proposed Port, operation and spoil disposal are not anticipated to substantially modify important habitat for these cetacean species.
… result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;	The Project is unlikely to lead to the introduction of any invasive fauna that could affect these cetacean species. RTA would conduct routine monitoring of the Port for marine pests, similar to that currently undertaken for Port of Weipa high-risk areas. There would be no ballast water exchange in the GBRWHA, and all vessels would be fully compliant with Australian quarantine regulations.
… seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Dolphins present within the Project area are not identified as representing a significant proportion of the population of their respective species. The Project area is not preferred habitat for Bryde's Whale and any occurrence would be sporadic. The Bryde's Whale is highly unlikely to occur in the Embley and Hey Rivers. There is the potential for alienation of cetaceans in the immediate vicinity of the Port and barge/ferry terminal areas primarily during construction activities, particularly during pile driving. Soft-start pile driving procedures are proposed to limit disturbance during pile driving activities. Disturbance in estuarine areas would be minor and not represent any substantial barrier to the movement of dolphins. Dolphins and whales would not be restricted in their movement around Port area wharf construction. Predicted Project-related shipping activities would mostly occur in deeper, open ocean environments and would not disrupt the lifecycle of dolphin or whale species along the shipping routes or in port areas. No significant impact to the lifecycle of dolphins is likely. No meaningful disruption to the lifecycle of the Bryde's Whale would occur as a result of the Project given that the Project area is not preferred habitat and any occurrence would be sporadic.