Darwin Ship Lift Project

Marine Megafauna Management Plan

41213-HSE-REP-D-1002

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Acknowledgement of Country

The Clough BMD JV respectfully acknowledges that the proposed Works outlined within this Plan will occur on the traditional Country of the Larrakia people from Darwin and its surrounds. We pay our respect to their elders past, present and emerging.

As the current and modern-day Traditional Custodians, we respectfully recognise the Larrakia community's deep-seeded and on-going relationship to the land and sea, through cultural beliefs, cultural heritage, caring for country and dreamtime stories. We embrace seeking greater cultural awareness, respect within the community and creation of beneficial outcomes, as we collaborate going forward.

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1 Introduction

1.1 Purpose

The Marine Megafauna Management Plan (MMMP) provides a framework for the management of potential impacts to marine megafauna associated with the Darwin Ship Lift Project. The MMMP supplements the DDSPMP, which satisfies condition 2-4 of Environmental Approval EP2023/028-001.

The MMMP has been developed in accordance with the following documents:

- *Environmental Protection Act 2019* (EP Act) Environmental Approval EPA2023/028-001
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action approval EPBC2021-9068
- Darwin Shiplift Project Dredging and Dredge Spoil Placement Management Plan (DDSPMP) (41213-HSE-PL-D-0001)
- Darwin Shiplift Project Construction Environmental Management Plan (CEMP) (41213-HSE-PL-G-1002)
- Darwin Shiplift Project Draft Environmental Impact Statement (AECOM, 2021)
- Darwin Shiplift Project Supplementary Environmental Impact Statement (AECOM, 2022)

1.2 Project Overview

The Northern Territory Government (NTG) is delivering the Project which comprises construction and operation of a ship lift facility and an adjacent maintenance facility at East Arm. The early design and procurement of the Project has been managed by a dedicated NTG Ship Lift Project Team within the Department of the Chief Minister and Cabinet (DCMC). Final procurement and construction will be managed by the Department of Infrastructure, Planning and Logistics (DIPL).

The Project will enable maintenance and servicing of a broad range of industries, including the Australian Defence Force (ADF) and Australian Border Force (ABF) vessels, as well as commercial and private vessels, including those servicing the oil, gas, pearling, fishing and other marine industries. It will be northern Australia's largest common user ship lift and will provide marine infrastructure that will deliver key services to northern Australia, acting as an enabler for the continued economic growth of Darwin as the logistics and marine services hub of the NT and northern Australia.

The Project is situated approximately 6.5 km south-east of the Darwin Central Business District, on the East Arm Peninsula within Darwin Harbour. The site is approximately 700 m east north-east of the East Arm Wharf (EAW) and the Marine Supply Base (MSB), and west of the Darwin Business Park. Road access is provided by Berrimah Road, linking the site to the Darwin road network including the Stuart Highway and Tiger Brennan Drive.

The location of the Project is shown in Figure 1.The approved extent as constrained by the EP Act Approval EPA2023/028-001 is provided in Figure 3.

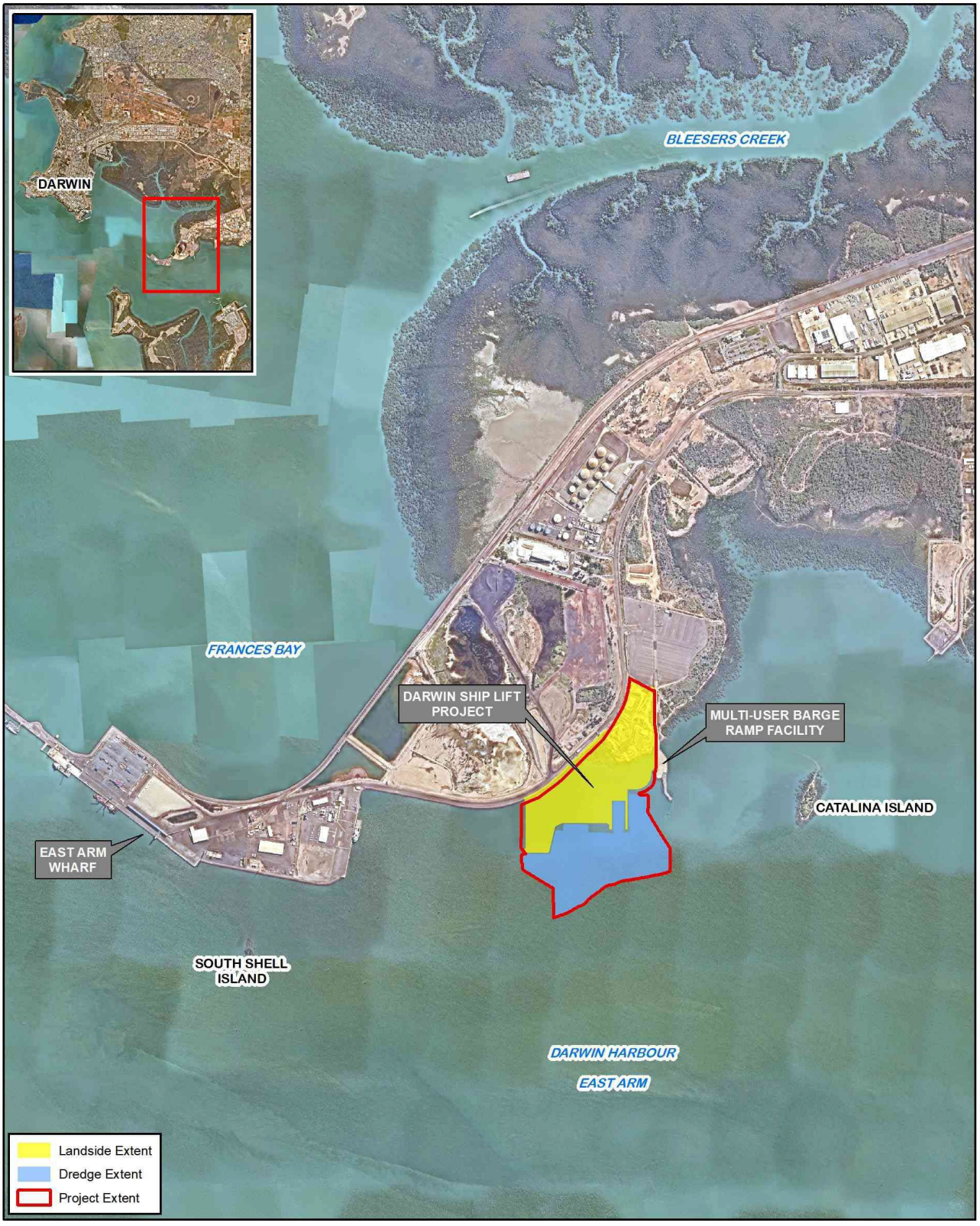

Figure 1 - Project Location

1.3 Project Footprint

The footprint of the Project when constructed will cover 29.7 ha and incorporate both land and water components. Within the project footprint, the following construction activities are anticipated:

- site preparation
- dredging
- transport of fill and materials
- land reclamation and revetments
- service installation, pavement sealing and paving
- piling
- infrastructure/component fabrication and installation
- corrosion protection

Figure 2 – Darwin Shiplift Project Layout including Dredging Footprint, and Settlement Ponds

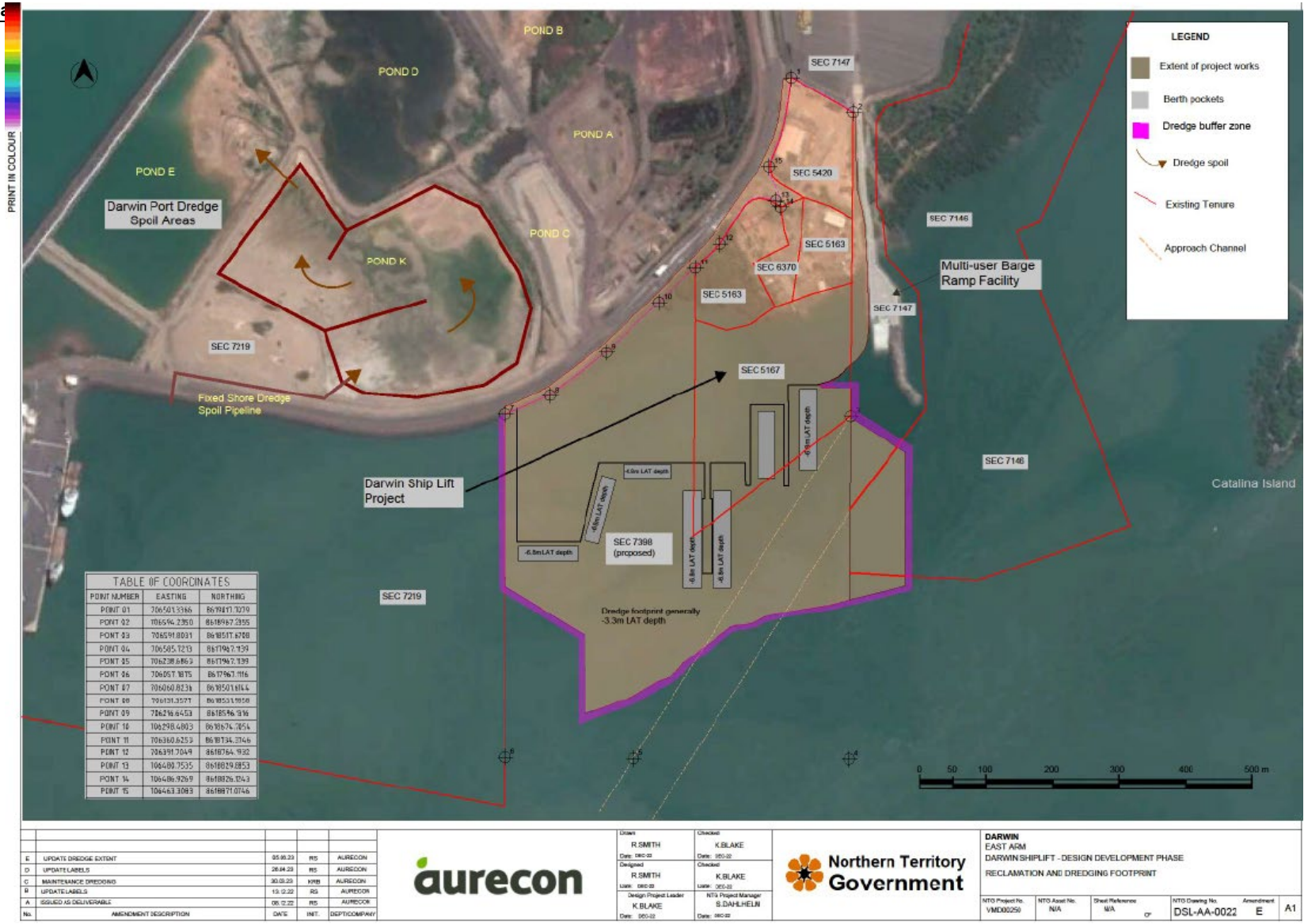

Figure 3 – Location for the proposed Action

1.4 Description of Works

To enable the construction of the Darwin Ship Lift Project it is estimated that approximately 9.2 ha of dredging will be required. The dredging consists of:

- ship lift minimum dredge level -7.5m lowest astronomical tide (LAT) (Declared dredge level -7.2mLAT).
- wet berths minimum dredge level -6.8mLAT (Declared dredge level -6.5mLAT)
- approach channel and manoeuvring basin areas at -3.3mLAT (Declared dredge level -3.0mLAT).

There are two components to the program for dredging the footprint of the wet berth and maneuvering basin areas:

- removal of approximately 173,430 cubic metres (m^3) of unconsolidated marine material
- removal of approximately 343,675 m^3 of consolidated materials.

1.4.1 Component 1 - Unconsolidated Material

The dredging campaign will be undertaken by using a small cutter suction dredge (CSD), similar to that used for the neighbouring MUBRF dredge campaign, to remove the unconsolidated material to settling ponds, then a backhoe dredge (BHD) to remove the consolidated stiff clays and rock for land reclamation.

The CSD, supported by work boats, will pump the unconsolidated material (via floating, submerged and/or overland pipelines) to the existing EAW settlement ponds. The final pipeline route will be determined by the Dredging Contractor in conjunction with the Contractor and Harbour Master.

The dredged material will be deposited into dredge Pond K, in which the larger particles (sands and silts) will settle out. The supernatant tailwater will then flow into Pond E (north), in which finer particles will settle out. Pond E (south) will provide a final settlement stage before discharge of the tailwater to Darwin Harbour via a permeable section of the bund wall. Testing of the water will take place prior to discharge to ensure all environmental targets are met.

The EAW settlement ponds have been utilised in this manner in the past for dredged material placement for the MSB and MUBRF dredging campaigns.

1.4.2 Component 2 - Consolidated Material

The reclamation area would be bunded and then progressively filled with consolidated material until the extent of the proposed reclamation is reached. Consolidated material would be removed by a BHD, placed into hopper barges and transferred into the reclamation area within the Project footprint. Sediment control measures such as silt curtains would be used to further minimise the release of sediments into the receiving environment from the reclamation area.

All dredging works will be undertaken in accordance with the approved DDSPMP and the Waste Discharge Licence.

Dredging is expected to be undertaken during both day and night-time hours, seven days per week. The dredging would not be continuous, and there would be periodic down time of the dredge (e.g. due to relocation of the dredge, shift changes, maintenance and weather interruptions). Other activities associated with the dredging (e.g. pipeline relocations, anchor relocations, movement of attendant work boats and barges) will also need to occur intermittently during both day and night time hours.

Dredging is expected to commence in March 2024 and conclude in October 2024.

1.5 Objectives and Targets

The Objectives relevant for this MMMP are:

Project construction activities must be carried out to achieve the environmental objectives included in Environmental Approval (EP2023/028-001), including the following:

- Protect the quality and productivity of water, sediment, and biota so that environmental values are maintained within Darwin Harbour
- Protect marine habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning within Darwin Harbour
- No material environmental harm to the environmental values and declared beneficial uses of Darwin Harbour beyond the approved extent, including but not limited to the quality or productivity of water, sediment and biota
- Dredging and land reclamation must not cause any adverse impact on water quality, or the condition or distribution of benthic communities or marine megafauna outside of the footprint and immediate surrounds, as indicated by monitoring required by condition 2-4(3) [of the EP Approval]
- Minimise the risk of physical injury, mortality, behavioural changes and health impacts on marine megafauna
- To implement measures for avoidance and minimization of impacts on marine megafauna, as indicated by condition 2-4(7) [of the EP Approval]

1.6 Legislative Requirements

The legislation, policies, standards, and guidelines of specific relevance to marine fauna are described below:

Commonwealth

- *Biosecurity Act 2015*
- *Environment Protection and Biodiversity Conservation Act 1999*
- National system for the prevention and management of marine pest incursions
- Anti-fouling and in-water cleaning guidelines.

Northern Territory

- *Environment Protection Act 2019*
- *Fisheries Act 1988*
- *Marine Act 1981*
- *Ports Management Act 2015*
- *Territory Parks and Wildlife Conservation Act 1976*
- Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory, Version 2.0.

2 Existing Marine Environment

Darwin Harbour is one of the least-disturbed working harbours in Australia and the Asia-Pacific region. The region's catchment extends from Charles Point in the west and Gunn Point in the east and covers approximately 3,230 km^2. The area includes the tributaries and estuarine areas of Cox Peninsula, West Arm, Middle Arm, East Arm, Blackmore River, and Howard River.

Several major river systems drain to the estuary (Blackmore, Elizabeth, and Howard) unlike other Australian cities which receive most of their catchment inflows from one large riverine system (DHAC 2020). Freshwater inflow into the Harbour occurs from January to April, when estuarine conditions prevail in all areas (Hanley 1988).Darwin Harbour supports a range of ecosystems including mudflats, mangroves, coral reefs, and seagrass. It is also home to varied animal life such as dolphins, dugong, sea turtles, shorebirds, sponges, and a large variety of fish (DLRM 2014).

The main channel of the Harbour is around 15-25 m deep, with a maximum depth of 36 m. The channel favours the eastern side of the Harbour, with broader shallower areas occurring on the west side. Intertidal flats and shoals are generally more extensive on the western side than on the eastern side. The natural channel continued into East Arm, towards Bladin Point, at water depths of more than 10 m below LAT. Over recent years, the bathymetry in this area has been modified by dredging and reclamation for the development and expansion of EAW and the construction of the INPEX LNG onshore processing plant on Bladin Point.

The Project location features shallow bathymetry (approximately 0 to 10 m below LAT), bounded by dredged channels for the adjacent marine facilities and offshore by the main East Arm channel.

Marine coastal processes, water and sediment quality, and marine ecological communities are described fully in AECOM (2021, 2022).

2.1 Marine Fauna

2.1.1 Protected Marine Species

Certain species within Darwin Harbour are protected under the following legislation and conventions:

- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which provides a legal framework to protect and manage nationally and internationally threatened plants and animals. The EPBC Act also considers potential impacts upon species listed under international treaties and conventions.
- The *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act). Under section 29 of the TPWC Act, the responsible Minister administers the NT Threatened Species List and assesses and classifies the conservation status of all wildlife species occurring in the NT. In this endeavor the Minister is supported by the relevant NT Government department, which is currently the Department of Environment, Parks and Water Security (DEPWS). Sightings of threatened species, as well as those considered to be 'significant', are recorded in the Natural Resource Maps NT database (Biodiversity (nt.gov.au)). In turn, these sightings are recorded in the Atlas of Living Australia (ALA 2021).
- The International Union for Conservation of Nature (IUCN) Red List of Threatened Species, which includes marine animals that are considered to be under threat of extinction.
- The Bonn Convention on migratory species.
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The threatened species that the EPBC Protected Matters Search Tool (PMST) database indicates may be found in the vicinity of East Arm, including the Project location, are listed in Table 1. However, it is noted that the database applies very broad distributions of species and their habitats and some of the listed species are not known to occur within Darwin Harbour. Hence, in relation to the species listed in Table 1:

- Humpback whales migrate to northern Australia from June to August but are not known to venture as far north-east as Darwin Harbour.
- Whale sharks are not known to occur within Darwin Harbour.

Table 1 Threatened species listed in the EPBC protected matters database as potentially occurring in the vicinity of the Project area

Scientific Name	Common Name
Cetaceans: Whales	
Megaptera novaeangliae	Humpback whale
Turtles	
Caretta caretta	Loggerhead turtle
Chelonia mydas	Green turtle
Dermochelys coriacea	Leatherback turtle
Eretmochelys imbricata	Hawsbill turtle
Lepidochelys olivacea	Olive ridley turtle
Natator depressus	Flatback turtle
Cartilaginous Fish	
Pristis clavata	Dwarf sawfish
Pristis microdon	Freshwater sawfish
Pristis zijsron	Green sawfish
Rhincodon typus	Whale shark

In addition to the species in **Table 1**, several other species known to be, or are potentially present in Darwin Harbour are listed as migratory species under the EPBC Act (**Table 2**). Dugongs and the dolphin species are discussed in sub-sections below. Bryde's and Humpback whales are not known to occur within Darwin Harbour, while Killer whales are regarded by Palmer et al (2017) to be occasional visitors to NT waters, though not specifically to Darwin Harbour.

Table 2 EPBC listed migratory species known to occur, or potentially occurring, in Darwin Harbour

Scientific Name	Common Name
Dugong dugon	Dugong
Balaenoptera edeni	Bryde's whale
Megaptera novaeangliae	Humpback whale
Orcinus orca	Killer whale
Orcaella heinsohni	Australian snubfin dolphin
Sousa sahulensis	Australian humpback dolphin
Tursiops aduncus	Spotted bottlenose dolphin
Crocodylus porosus	Estuarine Crocodile

2.1.2 Cetaceans

Three species of coastal dolphin are the most commonly recorded cetaceans in Darwin Harbour: the Australian humpback (*Sousa sahulensis*; formerly known as the Indo-Pacific humpback), Indo-Pacific bottlenose (*Tursiops aduncus*) and Australian snubfin (*Orcaella heinsohni*) dolphins (Palmer 2008). INPEX (2011) details knowledge of the taxonomy, distribution, microhabitats, residency, and site fidelity of the three species of coastal dolphins, while Brooks and Pollock (2014), Brooks et al (2017) and Griffiths et al (2020) present data from the extensive surveys undertaken for the INPEX Ichthys LNG project. In addition, the conservation status of coastal dolphins in the NT has been assessed by Palmer et al (2017).

Other species of dolphin that may be present in Darwin Harbour include Common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus g*riseus), Spotted dolphin (*Stenella attenuata*) and Bottlenose dolphin (*Tursiops truncatus*). Pods of False killer whales (*Pseudorca crassidens*) are considered by Palmer et al (2009) to be regular visitors to the harbour. It is notable that all cetaceans are protected under the EPBC Act.

Griffiths et al (2020) summarise the outcomes of studies of the abundance, movements, and habitat use of coastal dolphins (Australian humpback, Indo-Pacific bottlenose, and Australian snubfin) in the Darwin region (Darwin Harbour, Bynoe Harbour and Shoal Bay). On the basis of data from surveys undertaken between 2011 and 2019, and model outputs based upon capture-recapture data from these surveys, Griffiths et al (2020) concluded the following:

- All three species typically occurred at low densities, exhibited substantial emigration, and had fluctuating population size.
- Humpback dolphins were the most commonly observed of the three species and there was demonstrable movement of this species between the three monitoring areas. Over the course of the monitoring program, there was a significant decrease in estimated abundance in Darwin Harbour a non-significant increase in Bynoe Harbour and a non-significant decrease at Shoal Bay.
- The Snubfin dolphin population was small and was considered to have the greatest variability in population size and the greatest degree of temporary emigration (i.e. temporarily leaving the study area). Modelling indicated a significant negative trend in estimated abundance over the course of the monitoring program.

- The Bottlenose dolphin population was the smallest, with an apparently high degree of temporary emigration and a significant overall decrease in estimated abundance.
- The reasons for the significant declines were considered to be unclear but were thought to potentially be related to population dynamics, environmental or anthropogenic factors.
- The estimated population density of each species appeared to be similar to average densities in NT coastal waters.
- The estimated population densities of Humpback and Snubfin dolphins appeared to be within the ranges of densities recorded in Western Australia and Queensland, while the estimated densities of Bottlenose dolphins in the Darwin Harbour region and the NT appeared to be lower than in similar northern Australian locations.
- The estimated temporary emigration rates were considered to be similar to those in coastal dolphin populations elsewhere in Australia and overseas.
- Apparent survival rates were considered to be similar to, or lower than, those reported elsewhere for the same species, though the difficulty in accurately assessing survival rates was recognised. It was considered that emigration probably had a greater influence on population growth than deaths.

It is noted that there are no known areas of critical feeding or breeding habitat for dolphins within the zone of potential effects from the development and operation of the Project. The Indo-Pacific humpback and the Australian snubfin dolphin appear to be opportunistic generalist feeders, eating a wide variety of fish both on the seabed and within the water column (Parra 2006). No calving areas have been identified in Australian waters for either species and little is known of their reproductive biology or population structure (Ross 2006, Parra et al 2006).

2.1.3 Dugongs

Dugongs are known to occur in Darwin Harbour waters, although in relatively low numbers. Dugongs have been recorded in higher densities at Gunn Point and the Vernon Islands, some 30–50 km to the north-east of the mouth of the harbour. Dugongs have also been observed in relatively high numbers at Bare Sand Island and Dundee Beach in Fog Bay, 60 km south-west of Darwin Harbour, and are known to travel long distances (Whiting 2008).

Cardno (2014b) compared the results of baseline surveys with four surveys undertaken throughout the dredging phases of the Turtle and Dugong Monitoring Program associated with the INPEX Ichthys project. This study revealed that dugongs were observed in varying numbers between surveys; however, no trends (including seasonal variations) were evident. There was a higher number of dugongs observed in shallower waters (6 – 10 m), generally in foraging areas where seagrass was present. Variation in dugong observed between surveys within sites was concluded to most likely be a result of short-term movement of dugongs to visit optimum foraging areas of seagrass.

During baseline surveys (June to October 2012) most sightings in Darwin Harbour were around Weed Reef, West Arm and near Bladin Point, as well as in the shallow regions of Shoal Bay. During later baseline surveys, most dugong sightings were around outer Darwin Harbour, with aggregations around mapped seagrass near Casuarina Beach (Cardno, 2014b).

During the first of the Dredging Phase surveys (May 2013), dugongs were predominantly sighted in outer Darwin Harbour, with only one dugong sighted near Weed Reef and another in the shallow areas in West Arm. During the Dredging Phase surveys in July/August and October 2013, no dugongs were sighted in the inner Darwin Harbour, while during the end of dredging survey (May 2014) three dugongs were sighted near Weed Reef (Cardno, 2014b).

During the two surveys undertaken in October 2013, sightings were concentrated around Casuarina Beach and were associated with areas of seagrass (Halodule sp.). Lower numbers were observed in this area in wet season surveys, and it was considered that the reduced seagrass coverage in this season was likely to have been a contributing factor (Cardno 2014b).

In general, it is considered that dugongs could occur anywhere in the harbour that could support seagrasses or macroalgae. Within Darwin Harbour, dugongs have been observed at Channel Island in Middle Arm, where they were thought to be feeding on macroalgae (Whiting 2002). However, there are anecdotal records of seagrass occurrence in the vicinity of the Channel Island boat ramp, and this may have been a contributory factor to their presence. While some macroalgal communities may be present in the vicinity of the Project area, substantially greater areas of potential foraging habitat for dugong exist elsewhere in the harbour (INPEX 2011).

2.1.4 Turtles

Six species of marine turtles are known to occur in NT waters. Of these, four (the Green, Hawksbill, Olive ridley and Flatback turtles) are considered to occur in the Darwin Harbour region (Whiting 2003). Loggerhead turtles are suspected to be infrequent users of the harbour and the Leatherback turtle is considered to be an oceanic species which is unlikely to occur in Darwin Harbour (Whiting 2003).

The shoreline throughout Darwin Harbour, and particularly in East Arm, consists largely of mangrove forests and mudflats and does not provide suitable nesting habitat for any species of turtle (INPEX 2010). The nearest nesting beach (used by the Flatback turtle) is located in the Casuarina Coastal Reserve near Lee Point on the north-eastern shore of the harbour. Turtles visiting the harbour are more likely to be foraging for food. Flatback and Hawksbill turtles forage on the filter feeder communities which are extensive in the harbour. The Hawksbill turtle also forages on seagrass and macroalgal communities in addition to filter feeders. Green turtles forage amongst seagrass and macroalgal communities (INPEX 2011).

Cardno (2014b) implemented the Turtle and Dugong Monitoring Program for the INPEX Ichthys project; this included aerial and land survey techniques to monitor the abundance and distribution of turtles around Darwin Harbour. They concluded that:

- Statistical analysis of population and density estimates formed in this study did not indicate that the distribution or abundance of these animals had changed since the baseline phase.
- During survey D4 (during dredging) 813 turtles were sighted, which was higher than the average number of turtles sighted per survey during the baseline phase (634 turtles), but approximately 17% lower than the number of turtles recorded during baseline survey B3 (984 turtles), undertaken at the same time of year (October 2012).
- Statistical analyses of turtle population densities did not detect any significant difference between the impact and control treatments in either phase, or between baseline and dredging phases, for either treatment. In contrast, estimates of turtle density based on raw observations were significantly higher at the control blocks compared with the impact block during the baseline phase, but not during the dredging phase. The observed temporal and spatial variation in turtle distribution and abundance was considered possibly to be a result of short-term movements in and out of specific areas, possibly due to avoidance behaviour and/or the pursuit of more optimal foraging areas.
- Turtle sightings were most frequently recorded within relatively shallow water habitat, most commonly in waters less than 5 m in depth; however, a small number were sighted in the deep-water channels near the Vernon Island (outside of Darwin Harbour) in waters greater than 30 m depth.
- Where benthic habitat type had been identified and mapped, turtles were primarily sighted in association with gravel, sand, and reef. Only 3% of turtle sightings were associated with mud habitat, the predominant habitat within, and around, the Project area.

A search of Fauna Atlas NT recorded sightings of both the Green turtle (*Chelonia mydas*) and the Flatback turtle (*Natator depressus*) in the Project area, neither of which are listed under NT legislation.

2.1.5 Estuarine Crocodiles

Whilst Estuarine (saltwater) Crocodiles (Crocodylus porosus) have the potential to occasionally occur in the Project area as they move between suitable foraging areas, the project will have no impact to Estuarine crocodiles as:

- they typically avoid areas of high vessel activity such as the dredging and spoil disposal locations.
- the project area does not contain any important habitat for the Estuarine Crocodile. There are only limited nesting sites for the estuarine crocodile available inside Darwin Harbour (Whiting 2003).

In addition, the EPBC notice (EPBC2021/9068) outlines that the only impacts that could occur to individual crocodiles because of the proposed action are temporary sub-tidal impacts and removal of basking habitat related to the project activities (including dredging and pile driving), however, there is no evidence that crocodiles use the project area for basking and other activities. This may be due to the dynamic environment of the existing site.

Therefore, the Project does not consider management actions specific to the protection of the Estuarine Crocodiles are required, and management actions adopted for other megafauna species (outlined in Section 2) are deemed sufficient for this species.

3 Risk Identification and Assessment

3.1 Potential Impacts and Risks

This sub-section provides an overview of pathways for potential impacts upon marine megafauna – dolphins, Dugongs, and turtles - attendant to construction of the Project. It broadly outlines the reasoning that leads to a conclusion that the Project does not represent a source of impacts with the potential to significantly impact upon the marine biological diversity or ecological integrity of East Arm, or of the broader Darwin Harbour. This is contingent upon the effective implementation of the management and mitigation measures described in Section 8.3.

3.1.1 Fauna interactions with vessels

The main risk of physical interaction with marine megafauna species will be in relation to the movement of dredge support vessels (e.g., Tug and Spoil barge, crew transfer vessel, tender vessel). The risk of direct impact to protected marine species from the operating dredge is considered to be very low. As the dredge will be stationary during most of the works, with the most mobile part of the equipment (the CSD cutter head or BHD bucket) generating noise and vibration which is likely to discourage any species that may be present from approaching sufficiently close to the dredge for them to be exposed to the risk of impact or entrainment. It is noted that exclusion devices to reduce the risk of entrainment of marine megafauna into dredges are only able to be applied to mobile dredges (e.g. Trailer Suction Hopper Dredges [TSHDs]) and not to stationary dredges such as the (potential) CSD and BHD to be used for the Project.

When moving between or within the dredging footprint, the dredge will transit at low speeds (<5 Kn) and only over small distances (tens of metres).

It should be noted that physical interactions between dredging vessels and marine species are a higher risk when mobile dredges such as TSHDs are used, or when dredged material is disposed offshore. Neither of these scenarios is applicable to the dredging for the Project.

Nevertheless, there will be monitoring, and management measures implemented to reduce the risk of physical interaction with protected marine species, as described in the Marine Megafauna Management Framework – vessel interaction, in Section 8.3.1. These measures will apply to the operation of the dredge and also to any other vessels engaged in the works

(e.g. crew transfer vessels).

3.1.2 Underwater Noise and Vibration

Underwater noise and vibration will be generated by dredging and piling activities; however, pile-driving presents the greater risk to marine fauna with respect to the effects of underwater noise. An extensive assessment and modelling of the risks and impacts of construction noise with respect to marine megafauna can be found in AECOM (2021) *Appendix G: Underwater Noise Technical Report* (Talis 2021).

Approximately 240 days of piling activity are predicted during the construction phase, employing both drilling and hydraulic hammering as pile-driving methods. Pile dressing is not required and therefore associated noise impacts are not considered.

The majority of the estimated 80 piles are located above mean low water, meaning that some noise- impact risk is mitigated due to characteristics of local tidal regimes. Shallow water sound attenuation is significant due to the reflective properties of the narrow seabed-sea surface interface; as a result, acoustic energy decays faster with distance from the noise source than in deeper water. This effect is particularly exacerbated for low frequencies in shallow water; this further reduces the distance from source that deleterious effects of piling and dredging noise may be encountered.

The impacts of construction noise on marine fauna are separated into two categories:

- The onset of (sub-lethal) injury, defined as permanent threshold shift (PTS), indicative of tissue injury within hearing organs. PTS is considered a reliable, conservative indicator of the onset of permanent, albeit slight, irreversible physical injury.
- Temporary threshold shift (TTS), indicative of reduced hearing sensitivity. This results primarily from fatigue, rather than injury, of hearing organs and is reversible. TTS therefore serves as a cautious indicator of the possible onset of reversible physiological effects.

As well as noise thresholds being classified as PTS and TTS, they are further split into:

- Impulsive sounds, which are typically less than a second in duration with a high peak pressure and rapid onset and decay. Pile-driving and blasting are examples of impulsive sound sources underwater (Gordon et al 2004, cited in Hastie et al 2019).
- Non-impulsive noise sources, which include a range of frequency band widths and can be brief, intermittent, or continuous in duration and do not demonstrate high peak sound pressure waves. Dredging, drilling and vessel noise are typically non-impulsive noise sources.

Both impulsive and non-impulsive noise can cause behavioural changes in marine megafauna, particularly over long exposure times. Behavioural changes may include changes in feeding and breeding behaviour, as well as differences in more complex ecological interactions. It is noted that there are no known areas of critical breeding or feeding habitat for protected marine species within the zone of potential effects from the development and operation of the Project. Estimates for distances from source for predicted effects of underwater noise are estimated for TTS, PTS and behavioural changes in *Appendix G: Underwater Noise Technical Report* (Talis 2021).

Key predictions from Talis (2021) are:

- Dredging:
    - Dugongs are predicted to potentially reach TTS onset at 90m from the dredge cutter, and only at high tide, with behavioural disturbances occurring at 50m distances from source.
    - Dolphins are predicted to potentially reach TTS onset earlier, at a distance of 170m at high tide, with behavioural disturbances at 50m.
    - No TTS thresholds are predicted to be exceeded at low tide, and at no point are PTS

levels predicted to be exceeded for either dugongs or dolphins.

- TTS onset for turtles is predicted to potentially be reached earliest, at distances of 240m at high tide and 100m at low tide. They are the only species predicted to potentially reach dredge-induced PTS onset, at 110m and 30m for high and low tides, respectively.

- Piling:
  - Dugongs are predicted to potentially reach TTS onset at 120m during low tide and 100m at high tide. Behavioural disturbances are predicted at 2200m and 1050m at low and high tides, respectively.
  - Dolphins are predicted to potentially reach TTS onset earlier than dugongs, at 360m and 300m for low and high tide, respectively. Unlike dugongs they are predicted to reach PTS onset at 40m and 30m for low and high tide, respectively. Predicted behavioural disturbance distances are the same as for dugongs.
  - Turtles are predicted to potentially reach TTS onset at 175m and 450m for low and high tides, respectively, whereas PTS onset is predicted to potentially occur at 100m and 150m for low and high tides, respectively. Behavioural disturbance onset is predicted to potentially occur only at high tide, at approximately 70m distant from the piling source.

From the simulation results, it is evident that the standard mitigation measure of assessing for the presence of dugongs, dolphins and turtles within Observation and Shut-down Zones prior to the commencement of (and during) dredging and piling activities is to be implementable for the Project works. That is, a dedicated marine fauna observer (MFO) will be able monitor out to the maximum distance at which TTS is predicted to occur (450m at low tide for turtles).

It is predicted that noise levels that could lead to behavioural disturbance will not extend across the width of East Arm. Hence, it is predicted that dredging and piling will not have the potential to disrupt the passage of dugongs, dolphins or turtles between Elizabeth River and Darwin Harbour.

It is considered that the mitigation and management measures to be incorporated into the environmental management plans described in Sections 8.3.2 and 8.3.3, will be appropriate to reduce the risk of significant impacts upon marine fauna to as low as reasonably possible.

3.1.3 Contaminant inputs during construction

AECOM (2021) considered the risk of contaminant inputs into the marine environment during construction, and found the following:

- Contaminants in terrestrial soils - With the application of standard management and mitigation measures specified in the Construction Environmental Management Plan (CEMP) (41213-HSE-PL-G-1002), the potential for impacts upon marine flora and fauna, and their habitats, from contaminants (if present) in any soil that may enter the marine environment during terrestrial construction works is sufficiently low.
- Acid sulfate soils - The reclamation of the Project area will progress seaward from the existing shoreline any mud waving that may occur would only expose ASS (if present) to air over those parts of the tidal cycle that they are not inundated by tidal waters. It is not considered a credible risk that the exposure times would be of sufficient duration for soil acidity levels to be raised to the extent that toxicants could be mobilised to a degree that they could pose a risk to marine flora and fauna in the vicinity of the Project area.
- Contaminants in marine sediments - When compared against established guideline criteria the concentrations of potential toxicants within the material to be dredged are below those which are considered to potentially pose a risk of significant impact to marine environmental quality. It follows, then, that they are also considered to be sufficiently low as to not pose a risk of significant impact to marine flora and fauna.
- Unplanned releases - Management and mitigation measures are specified in the CEMP to

reduce the potential for contaminant inputs including spills of hydrocarbons or chemicals during construction to enter the marine environment via surface water runoff. It is considered that, with the effective implementation of management and mitigation measures, the risk of impacts to marine flora and fauna from these toxicant sources will be as low as reasonably possible.

3.1.4 Lighting

Artificial light can disrupt critical behaviours in wildlife, stalling the recovery of threatened species and interfering with a migratory species' ability to undertake long distance migrations integral to its life cycle.

Light pollution was identified as a high-risk threat in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) because artificial light can disrupt critical behaviours such as adult nesting and hatchling orientation, sea finding and dispersal, and can reduce the reproductive viability of turtle stocks. Light is likely to affect the turtles if it can be seen from the nesting beach, nearshore or adjacent waters.

The effect of artificial lights on turtles is most pronounced at nesting beaches and in the nearshore waters, which might include interesting areas, through which hatchlings travel to reach the ocean.

The National Light Pollution Guidelines for Wildlife (DCCEEW, 2023) discusses the impacts of artificial light on wildlife including marine turtles, seabirds, and migratory shorebirds. In regard to marine turtles, impacts are observed the greatest on nesting adults and hatchling orientation.

3.2 Statement of Residual Risk

Assessments of the risks of potential impacts on marine flora and fauna are summarised in Table 7. Risks were assessed both prior to mitigation and following the implementation of the mitigation measures within the Marine Megafauna Management Frameworks detailed above, to provide an assessment of residual risk.

The residual risk assessment indicates that there is a Medium risk of impacts to marine fauna from vessel strike. Given the Major consequence that would arise if vessel strike upon a protected marine species was to occur, it is not possible to reduce the residual risk rank to lower than Medium. This highlights the need to effectively implement surveillance protocols and controls on vessel speeds within the vicinity of the Project area. It is noted that surveillance protocols are routinely implemented by vessels traversing the harbour, to mitigate the risk of collision with floating objects that may result in damage to the vessels; these will also be effective in reducing the risk of vessel strike of protected species to as low as reasonably possible.

The residual risk to marine fauna attendant to all other impact sources is considered, with the implementation of the mitigation measures within the Marine Megafauna Management Frameworks provided above, to be Low.

With regards to significant marine species and habitats, due to limitations in survey techniques (i.e. observations have only been made on discrete occasions, and only during daylight hours), there is inherent uncertainty around whether significant marine species will be present within the vicinity of Project construction and operation activities and, therefore, if they will be potentially vulnerable to disturbance or direct impact. However, the management and mitigation measures included within the plans listed in the Marine Megafauna Management Frameworks provided above have been developed on the assumption that these species may be present in the vicinity of the Project at some time of the day or night, and during some seasons.

Table 3 Pre and post-mitigation risk assessment for marine fauna

Aspect	Pre-mitigation risk rating	Mitigation measures	Post-mitigation risk rating
Dredging and reclamation – liberation of sediments into water column (turbid plumes)	Medium	Preparation and implementation of Dredging and Dredge Spoil Placement Management Plan (DDSPMP) (41213-HSE-PL-D-0001), including monitoring and reactive management protocols.	Low
Dredging and reclamation – underwater noise and vibration	Medium	Implementation of the Construction Environmental Management Plan (CEMP), and DDSPMP, including monitoring and reactive management protocols. Implementation of mitigation measures provided in the Marine Megafauna Management Framework – Underwater noise, dredging.	Low
Piling - underwater noise and vibration	Medium	Implementation of the CEMP, and DDSPMP, including monitoring and reactive management protocols. Implementation of mitigation measures provided in the Marine Megafauna Management Framework – Underwater noise, piling.	Low
Discharges of contaminants from terrestrial activities	Medium	Implementation of the CEMP (Erosion and Sediment Control Plan and Spill Prevention and Response Procedure). Compliance with AS1940-2004 (Storage and handling of flammable and combustible liquids).	Low
Potential to generate acidic and metal drainage	Medium	Implementation of the CEMP (Potential Acid Sulfate Soils Management Plan). Adoption of construction methodologies that reduce potential for mud waving to as low as reasonably possible.	Low
Vessel discharges – hydrocarbon or chemical spills	Medium	Implementation of the CEMP (Spill Prevention and Response Procedure). Compliance with AS1940-2004 (Storage and handling of flammable and combustible liquids).	Low
Marine traffic impacts – vessel strike	High	Implementation of the Marine Megafauna Management Framework – Physical interaction. Implementation of standard navigational procedures and navigation aids.	Medium
Lighting impacts on marine fauna	Low	Implementation of the Marine Megafauna Management Framework – Lighting, dredging.	Low

4 Mitigation and Management

To support the achievement of the environmental objectives and outcomes, piling and dredging must be implemented in such a manner that:

1. isolates from Darwin Harbour all material (dredged and imported fill) used for reclamation by constructing an appropriately engineered rock revetment to fully enclose the reclaim area prior to placement of fill material, and
2. prevents the generation of turbid plumes during construction of the rock revetment, and
3. protects any locations where runoff or suspended sediments may enter harbour waters from the reclamation area and dredge spoil ponds with geofabric and/or silt curtains, and
4. avoids the overflow of entrained water and sediment from dredge spoil barges.

To manage the potential for impacts to marine megafauna during construction, mitigation measures have been proposed below.

The management of spills and contamination are provided in the *Spill Prevention and Response Procedure* (prepared in accordance with the Darwin Port Oil Spill Contingency Plan and the Northern Territory Oil Spill Contingency Plan) the *Potential Acid Sulfate Soils Management Plan*, and the *Erosion and Sediment Control Plan*, provided in the CEMP.

4.1 Physical Interaction

Table 4 Marine Megafauna Management Framework – Physical Interaction

Element	Vessel interaction with marine megafauna
Objectives	Minimise the risk of injury to, or mortality of, marine megafauna species. Develop and maintain awareness of the need to conserve marine megafauna species.
Targets	1. No incidents of vessel interaction with protected marine species. 2. All dredging personnel to complete an HSE induction, including marine megafauna species awareness and management requirements. 3. All vessel masters competent in marine megafauna species interaction procedures.
Key Performance Indicators	• Number of incident reports. • Number of reported sightings of live, injured, or dead marine megafauna species. • Number of personnel completing the Project Induction.
Management	• Training of Vessel Masters in interaction procedures • During movements of Project vessels, if marine megafauna species are sighted within 50m of a vessel, then avoidance actions will be taken by the vessel (e.g. change of direction or slowing to less than 6 knots) until the individuals are no longer within this distance. • Vessels will adhere to Darwin Port speed restrictions.

	• Vessels will not approach, circle, or wait in front of marine megafauna species for the purposes of casual viewing. • Support vessels will not approach, circle, or wait in front of wildlife for the purposes of casual viewing.
Monitoring	Watch will be maintained for stranded, injured, or dead marine megafauna fauna; if observed, the NT Government Marine Wildwatch line (1800-453-941) will be contacted for retrieval, treatment, or post-mortem of the fauna.
Reporting	• Daily submission of marine fauna observations sheets by Dredging Contractor to the Project HSSE Manager (example shown in **Appendix 1**). • Weekly summary reporting by Dredging Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Monitoring report to the Territory at the conclusion of dredging in accordance with the DDSPMP. • Any vessel interaction incidents and marine megafauna species injury or mortality will be reported to the Project HSSE Manager within 24 hours of the incident occurring. The Contractor will notify DEPWS and DCCEEW.
Corrective Actions	• In the event that an incident or near miss occurs between vessels and protected marine species, the incident will be investigated and discussed to further improve awareness to reduce risk of collision. • For mobile vessels associated with the Project, a 5 Kn vessel speed limit will be applied in areas where frequent sightings (an average of >1 per day in any one week) are made of protected marine species.
Term	For the duration of dredging activities
Responsibility	Vessel Operators to ensure Vessel Masters implement marine megafauna species interaction procedures in compliance with this Marine Megafauna Management Framework – vessel interaction. Project Manager for Vessel Operators to liaise with Contractor, DIPL and DEPWS on response to stranded, injured or dead protected marine species and potential recovery, treatment or post-mortem.

4.2 Underwater Noise - Dredging

Table 5 Marine Megafauna Management Framework – Underwater Noise, Dredging

Element	Impact of underwater noise on marine megafauna species from dredging activities.
Objectives	Minimise the risk of disturbance to marine megafauna species from underwater noise during dredging activities. Establish and maintain awareness of the importance of protecting marine megafauna species during dredging activities.
Targets	1. No avoidable disturbance to marine megafauna species as a result of noise generated during dredging activities. 2. All dredging personnel to complete an HSE induction. 3. At all times that dredge is operational, at least one crew member hold an accreditation to act as a dedicated MFO
Key Performance Indicators	• Number of audits and incident reports. • Number of reported sightings of live, injured, or dead marine megafauna species. • Number of personnel completing an HSE site induction. • Availability of MFO crew member on operating dredge.
Management	• MFO to undertake assessments of the Observation, Start-up Exclusion and Dredging Response Zones as follows. • On each occasion that the dredge has been non-operational for a period exceeding 30 minutes, a visual assessment will be undertaken of the 750m radius Observation Zone by the MFO for a period of 20 minutes. Dredging will not recommence until no marine megafauna species have been sighted within the 500m radius Start- up Exclusion Zone for a period of 10 minutes. • The assessment of the Observation Zone will be made from an elevated position on the dredge, where a clear line of sight is achievable to the edge of the zone. • The MFO will not be engaged in any other activities during the 20-minute assessment period. • Every 30 minutes whilst the dredge is operating, the MFO will dedicate a period of five minutes for scanning (from an elevated position) for marine megafauna species within the Observation Zone. • Once dredging operations have commenced, if marine megafauna species enter within 50 m of the dredge, or a dolphin with calf enter within 150 m of the dredge (i.e. the Dredging Response Zones), then dredging will be temporarily suspended. Dredging will not recommence until no marine megafauna species have been sighted within the 500m radius Start-up Exclusion Zone for a period of 30 minutes. • Dredging that commences prior to sunset, or prior to a period of low visibility (defined as where continuous visual observations to a

	distance of 1000m from the dredge are not possible), will continue unless, within the preceding 12 hours, there have been three or more suspensions of dredging due to marine megafauna species encroaching within the Dredging Response Zone. • The generation of underwater noise by all vessels will be reduced by ensuring that: - All equipment is maintained in good operating condition (balancing, greasing, etc.) and have proper noise control systems in place. - All noise minimisation measures such as mufflers, special enclosures and sound-insulation mounts are fitted and working. - Revolving equipment such as propellers and drive shafts are balanced to reduce vibration. - Equipment such as thrusters and auxiliary plant are switched off when not in use (i.e. not running in standby mode). • During periods of low visibility (where observations cannot extend to the extent of the exclusion zone e.g heavy rain or fog or periods of high winds), piling will continue: - unless, within the preceding 12 hours, there have been three or more suspensions of works due to marine megafauna species encroaching within the dredge exclusion zone. - If operations were not previously underway during the preceding 24 hours, providing no fauna of interest has been sighted in the exclusion zone. • During low visibility, where conditions allow, visual observations of the 500-metre exclusion zone from the dredge shall be maintained continuously to identify if there are any marine megafauna present. • During night or poor visibility, undertake last suitable light searches of the area where possible to determine if marine megafauna are present.
Monitoring	• Marine megafauna species observations (as per Management section above). • Watch will be maintained for the presence of stranded, injured, or dead marine megafauna species. If observed, the NT Government Marine Wildwatch line (1800-453-941) will be contacted for retrieval, treatment or post-mortem of the animal(s).

Reporting	• Daily submission of marine fauna observations sheets by Dredging Contractor to the Project HSSE Manager (example shown in **Appendix 1**). • Weekly summary reporting by Dredging Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Monitoring report to the Territory at the conclusion of dredging in accordance with the DDSPMP. • Any suspected noise-related incidents will be reported by Dredging Contractor to the Project HSSE Manager within 24 hours of the incident occurring.
Corrective Actions	• In the event that noise-related impact is suspected, the incident will be investigated to confirm a noise-related impact has occurred and identify the most appropriate action(s) to reduce the impact. This may include one or more of the following: - Implementation of further noise reduction measures. - Restriction on vessel movements/activities. - Increase in the radius of the Observation Zone to 900 m.
Term	For the duration of dredging activities
Responsibility	Dredging Contractor to ensure works are conducted in compliance with this Marine Megafauna Management Framework – underwater noise, dredging. Dredging Contractor to implement noise management aboard all vessels.

4.3 Underwater Noise - Piling

Table 6 Marine Megafauna Management Framework – Underwater Noise, Piling

Element	Impact of underwater noise on marine megafauna species from piling activities.
Objectives	Minimise the risk of disturbance to marine megafauna species from underwater noise from piling activities. Establish and maintain awareness of the importance of protecting marine megafauna species.
Targets	1. No avoidable disturbance to marine megafauna species as a result of noise generated during piling activities. 2. All piling personnel to complete an HSE induction. 3. At all times that piling is carried out, at least one person is a dedicated MFO.
Key Performance Indicators	• Number of incident reports. • Number of reported sightings of live, injured, or dead marine megafauna species. • Number of personnel completing an HSE site induction. • Availability of MFO personnel during piling activities.
Management	Marine Piling Management: • Marine piling exclusion zones will be established and implemented so as to ensure that marine megafauna are not exposed to sound exposure levels (SEL) of greater than or equal to 183 dB re 1µ Pa2.s for longer than 5 continuous minutes. The marine piling exclusion zones shall consider the range of marine piling source energy and the marine piling exclusion zones must not be less than 500 metres from the pile hammer. • Visual observations for marine megafauna must be undertaken to the extent of the marine piling exclusion zones by a dedicated MFO, for at least 30 minutes before the commencement of marine piling activities. • During piling activities, visual observations covering the extent of the marine piling exclusion zones shall be maintained continuously to identify if there are any marine megafauna present. • If marine megafauna are sighted within the marine piling exclusion zones, action to cease all marine piling within 2 minutes or as soon as is safely possible. • Marine piling activities must not recommence until marine megafauna are observed to move outside the marine piling exclusion zones or 30 minutes have passed since the last sighting. • Marine piling activities must commence with soft-start procedures, by gradually increasing the piling impact energy for a period of no less than 15-minutes from the commencement of piling to alert marine megafauna to the presence of piling activities, enabling the marine

	megafauna to move away on their own accord. The soft-start procedures may only commence if no marine megafauna have been sighted within the marine piling exclusion zone during the pre-start up visual observations.
	• Piling undertaken during daylight hours only.
	Onshore Piling Management:
	• Establish a 500-metre exclusion zone for marine megafauna.
	• Visual observations for marine megafauna shall be undertaken to the 500-metre exclusion zone by a dedicated MFO for at least 30 minutes before the commencement of piling activities.
	• During piling activities, visual observations of the 500-metre exclusion zone from the pile hammer shall be maintained continuously to identify if there are any marine megafauna present.
	• If marine megafauna are sighted within the 500-metre exclusion zone, action to cease all piling within 2 minutes or as soon as is safely possible.
	• Piling activities must not recommence until megafauna are observed to move outside the 500-metre exclusion zone or 30 minutes have passed since the last sighting.
	• Piling activities must commence with soft-start procedures, by gradually increasing the piling impact energy for a period of no less than 15-minutes from the commencement of piling to alert marine megafauna to the presence of piling activities, enabling the marine megafauna to move away on their own accord. The soft-start procedures may only commence if no marine megafauna have been sighted within the 500-metre exclusion zone during the pre-start up visual observations.
	• Piling undertaken during daylight hours only.
	• During periods of low visibility (where observations cannot extend to the extent of the exclusion zone e.g heavy rain or fog or periods of high winds), piling will continue:
	  • unless, within the preceding 12 hours, there have been three or more suspensions of works due to marine megafauna species encroaching within the marine piling exclusion zone.
	  • If operations were not previously underway during the preceding 24 hours, providing no fauna of interest ha been sighted in the exclusion zone.
	• During low visibility, where conditions allow, visual observations of the 500-metre exclusion zone from the pile hammer shall be maintained continuously to identify if there are any marine megafauna present.

Monitoring	• Marine megafauna species observations (as per Management section above). • Watch will be maintained for the presence of stranded, injured, or dead marine megafauna species. If observed, the NT Government Marine Wildwatch line (1800-453-941) will be contacted for retrieval, treatment, or post-mortem of the animal(s).

Reporting	• Daily submission of marine fauna observations sheets by Piling Contractor to the Project HSSE Manager (example shown in **Appendix 1**). • Weekly summary reporting by Piling Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Any suspected noise-related incidents will be reported by Piling Contractor to the Project HSSE Manager within 24 hours of the incident occurring.
Corrective Actions	Marine Piling Management: • If marine megafauna are sighted within the marine piling exclusion zones, action to cease all marine piling within 2 minutes or as soon as is safely possible. • Marine piling activities must not recommence until marine megafauna are observed to move outside the marine piling exclusion zones or 30 minutes have passed since the last sighting. Onshore Piling Management: • If marine megafauna are sighted within the 500-metre exclusion zone, action to cease all piling within 2 minutes or as soon as is safely possible. • Piling activities must not recommence until marine megafauna are observed to move outside the 500-metre exclusion zone or 30 minutes have passed since the last sighting.
Term	• For the duration of piling activities
Responsibility	• Piling Contractor to ensure works are conducted in compliance with this Marine Megafauna Management Framework – underwater noise, piling.

4.4 Lighting - Dredging

Table 7 Marine Megafauna Management Framework – Lighting, dredging

Element	Lighting impacts on marine turtle species during dredging activities.
Objectives	Minimise the risk of disturbance to marine turtle species from lighting during dredging. Establish and maintain awareness of the importance of protecting marine turtle species.
Targets	1. Reduction of light spill into marine environment from dredge vessels to as low as practically possible. 2. All dredging personnel to complete an HSE induction. 3. At all times that dredge is operational, at least one crew member is a dedicated MFO.
Key Performance Indicators	• Number of incident reports. • Number of reported sightings of live, injured, or dead marine turtle species. • Number of personnel completing an HSE site induction. • Availability of MFO personnel during dredging activities.
Management	• Reduction of light spill into marine environment from dredge vessels to as low as practically possible. • Avoid direct light shining into the water. • Avoid lights containing short wavelength violet/blue light. • Avoid white LEDs. • Avoid high intensity light of any colour. • Use only the minimum number and intensity of lights needed to provide safe and secure illumination required to meet the lighting objectives, including health and safety requirements. Avoiding light fixtures surplus to needs will decrease overall light emissions. • Where compliant with health and safety requirements, white lights should be avoided, and amber/orange lights used instead. If white lights are required, filters to block green, blue, violet, and ultra-violet wavelengths should be applied. • Lights that are not required to be continuously lit to be motion activated, put on a timer, or wired to allow manual ON/OFF operation. • Use flashing/intermittent lights instead of fixed beam, for example, small red flashing lights can be used to identify an entrance or delineate a pathway. • All non-essential lighting to be automatically switched off. • Lighting design for above-water infrastructure to be in accordance with national guidelines.

Monitoring	• Conduct regular inspections and audits of the dredge vessel and undertake monitoring of specific environmental aspects and impacts. • Conduct monitoring to assess whether the management actions are effective against the environmental objectives.
Reporting	• Daily submission of marine fauna observations sheets by Dredging Contractor to the Project HSSE Manager (example shown in **Appendix 1**). • Weekly summary reporting by Dredging Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Any suspected noise-related incidents will be reported by Dredging Contractor to the Project HSSE Manager within 24 hours of the incident occurring.
Corrective Actions	• In the event that light-related impact is suspected, the incident will be investigated to confirm a light-related impact has occurred and identify the most appropriate action(s) to reduce the impact. This may include one or more of the following: - Implementation of further light reduction measures. - Restriction on vessel movements/activities. - Increase in the radius of the Observation Zone to 900 m.
Term	For the duration of dredging activities
Responsibility	Dredge Contractor to ensure works are conducted in compliance with this Marine Megafauna Management Framework – lighting, dredging.

5 Monitoring

At all times that the dredge is operational, the crew will include at least one member that is assigned the duty of Marine Fauna Observer (MFO). As described in Section 8.3 the MFO will be responsible for undertaking visual assessments for marine megafauna of the 750 m radius Observation Zone around the dredge. The assessment of the Observation Zone will be made from an elevated position on the dredge, where a clear line of sight is achievable to the edge of the zone. The MFO will not be engaged in any other activities during the dedicated assessment periods.

Procedures for the protection of marine megafauna potentially vulnerable to dredging noise will be as follow:

- Prior to the commencement of any dredging, an Observation Zone extending 750 m in all seaward directions from the dredge will be established.
- From 20 minutes prior to the commencement of any dredging, an MFO will monitor the Observation Zone to check for the presence of any marine megafauna species.
- If any individual of a marine megafauna species is observed within a 500 m radius Start-up Exclusion Zone, then noise-intensive dredging activities will not commence until the animal is observed to have left this zone, or until 30 minutes have elapsed since the last sighting.

During dredging, at 30-minute intervals the designated MFO will check the Observation Zone for a period of five minutes. Once dredging activities have commenced, if any marine megafauna species approach within 50 m of the dredge, or a dolphin with calf enters within 150 m of the dredge (i.e. the Dredging Response Zones), the sightings will be recorded (including details of the time and results of observation) and the management measures described in Section 8.3 will be implemented.

The Dredging Contractor will provide awareness training to selected crew members to inform them about the marine megafauna species which may occur within Darwin Harbour; to provide a description of the record form to be used for recording marine species sightings; and to explain how to apply appropriate avoidance and mitigation measures to minimise the potential for impacts or collisions with marine megafauna. The purpose of the training will be to raise awareness; to encourage recording and reporting of marine species sightings; and to emphasise the requirement to report stranded, injured, or dead marine megafauna species regardless of what caused the injuries or deaths.

All sightings of marine megafauna species will be recorded by the MFO on marine fauna observation forms similar to that presented Appendix 1; these will be available on all Project vessels. These records will be provided to the Project HSSE Manager and logged into the Project's marine megafauna sighting register.

The Dredging Contractor will be responsible for reporting sightings of any EPBC-listed marine fauna to the Project HSSE Manager, who will in turn report these sightings to the relevant authorities within 24 hours. This includes where there is injury or mortality to a listed threatened or migratory species that may be attributable to the dredging activity. The report will include details of the individual species observed, the frequency, location and timing of observations, and photos (if available). The objective of these reports will be to identify potential interaction areas which will be incorporated by the Dredging Contractor into pre-starts, toolboxes, marine fauna awareness training, or other general awareness sessions.

6 MMMP Review

Consistent with the requirements of the EP Approval, this MMMP has been reviewed by an independent qualified person to ensure it is consistent with the achievement of the environmental objectives specified in the approval.

The MMMP, it's operation and implementation will be periodically reviewed during project delivery. Formal review of the MMMP will be implemented at least once every 6 months.

Other triggers for review may include:

- Corrective or Preventative Actions are raised through the reporting process requiring amendments to the MMMP;
- Changes to relative legislative, regulatory or compliance obligations;
- Significant changes to any constituent of project construction;
- Request by the Client or any regulatory authority;
- Significant changes to the environment;
- Changes to Best Practice Environmental Management; or
- Identification of new environmental risks.

The Environmental Representative (or Project Manager nominee) will be responsible for review and amendment of the MMMP. If updated at any stage of the project, a revised copy will be submitted to all relevant stakeholders.

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Appendix 1 Marine Fauna Observer Record Sheet

Name:	Date:
Employer:	Day or Night Shift:

Time	Reported Observations & Actions							
	Species[1]	No.	Calves (Y/N)	Distance (m)	Mitigation Response[2]	Beaufort state	Comment	Initial

1- Record the species as accurately as you can. If unsure, use the general terms "dolphin", "turtle", "sawfish", etc.

2- If no mitigation response is required, you should still record this. Take photos if possible

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Final Audit Report 2024-01-10

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