Attachment 4 - Assessment of Potential Impacts on EPBC Act Threatened and Migratory Species

Introduction

It is recognised that the proposed Toondah Harbour development has the potential to have a significant impact on species listed as Threatened or Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and therefore the project will be a controlled action to allow more detailed assessment to be carried out.

An EPBC Act Protected Matters Search for the site using a 5 kilometre buffer zone (refer to **Attachment 2**) identified the following as having potential to occur on, or in vicinity to, the site:

- 3 Listed Threatened Ecological Communities:
  - *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland* (endangered) - community likely to occur within the area
  - *Lowland Rainforest of Subtropical Australia* (critically endangered)- community likely to occur within the area
  - *Subtropical and Temperate Coastal Saltmarsh* (vulnerable) - community likely to occur within the area;
- 10 listed threatened flora species;
- 56 listed threatened fauna species; and
- 76 listed migratory Species.

A number of flora and fauna surveys including desktop (government databases, regional level studies, etc) and site specific ecological field surveys have been carried out at the site. This includes detailed terrestrial (BAAM 2017) and aquatic (FRC environmental 2017) ecological studies within and adjacent to the PDA. Specific investigations relevant to the Ramsar wetland include:

- Benthic habitat survey within and adjacent to the PDA;
- Migratory shorebird surveys including five summer and one winter survey carried out between October 2014 and June 2015;
- Review of 20 years of high tide surveys conducted by the Queensland Wader Study Group at a high tide roost site to the south of the PDA (Nandeebie Claypan); and
- On ground confirmation of remnant vegetation communities and mangrove and intertidal vegetation; and
- Assessment of the likelihood of protected marine and intertidal flora and fauna utilising the site.

The technical reports and summaries detailing the outcomes of the assessment are provided in response to sections 2.4 and 2.5 of the referral (refer to **Attachments 5 and 6** to the referral).

Threatened and Migratory Species Assessment Summary

A likelihood of occurrence assessment has been carried out by BAAM (terrestrial species including wader birds) and FRC environmental (marine species) using information from the desktop and field surveys assessing the potential for each threatened species and community to utilise the site. For detailed assessment of the likelihood of occurrence all species identified by the PMST search refer to **Attachments 5** and **6**. Those species considered to have a moderate or high likelihood of utilising the site are summarised in **Table 1**.

Migratory Species Likelihood of Occurrence

The protected matters database searches identified 17 marine, six terrestrial and 33 wetland bird migratory species as well as 20 marine migratory species (including whales, turtles and sharks) that may occur within the study area or surrounds.

Eleven migratory bird species (including three critically endangered and one vulnerable species as addressed in Table 1) were recorded within or immediately adjacent to the study area during field surveys, and a further eight species were identified as having the potential to occur based on database records for the local area and presence of suitable habitat. The remaining species or were assessed as unlikely to occur.

Refer to **Attachment 6 – Terrestrial Ecology Assessment** – of the referral for detailed assessment of these species.

Five marine migratory species (including whales, turtles and sharks) including two vulnerable and one endangered species as addressed in Table 1 were identified as having a moderate or high potential to occur within or near Toondah Harbour based on field survey, database records for the local area and presence of suitable habitat. The two marine migratory species not listed as threatened are the Dugong and Indo-Pacific humpback dolphin. These species were considered likely to occur as:

- Indo-Pacific humpback dolphins are known to occur in Moreton Bay and have a preference for shallow coastal and estuarine areas. They are likely to feed in or traverse marine habitats of the Toondah Harbour project area.
- Moreton Bay supports feeding and breeding populations of dugong. Dugong have been observed near Toondah Harbour and are likely to occur within the marine habitats of the Toondah Harbour project area, particularly in the seagrass beds.

Refer to **Attachment 5 – Marine Ecology Assessment** – of the referral for detailed assessment of these species.

Table 1: EPBC Act Threatened Species Likely to Utilise the Site

Common Name	Species	EPBC Act Threatened Status	Ecology	Likelihood of Occurrence
Loggerhead Turtle	*Caretta caretta*	Endangered	Loggerhead turtles are primarily found around coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia. Moreton Bay is an important foraging ground for the loggerhead turtle. Feeding Areas The loggerhead turtle forages in a wide range of intertidal and subtidal habitats, including coral and rocky reefs, seagrass meadows, and non-vegetated sand or mud areas. They tend to maintain small home ranges within their foraging grounds (within approximately 10 to 15 km of coastline). Moreton Bay is an important foraging ground for the loggerhead turtle. Breeding Areas Loggerhead turtles nest on open, sandy beaches. The three major nesting areas for loggerhead turtles in Queensland are in the Great Barrier Reef, and include: ▪ the Capricorn Bunker Island Groups, especially Wreck, Tryon and Erskine islands ▪ Mon Repos and adjacent beaches of the Woongarra Coast and Wreck Rock Beach, together with ▪ the islands of the Swain Reefs, especially Pryce Island and Frigate, Bylund, Thomas and Bacchi cays. A small number of loggerhead turtles nest on the local sand islands of Bribie, Moreton, and North and South Stradbroke. Key Threats Key threats include commercial and recreational fishing, coastal infrastructure and development (including industrial, residential and tourism development), Indigenous harvest, feral animal predation, and climate change.	Moderate - Moreton Bay supports a significant loggerhead turtle feeding population. Loggerhead turtles are moderately likely to occur in marine habitats within and adjacent to the Toondah Harbour project, particularly in the seagrass beds.
Green Turtle	*Chelonia mydas*	Vulnerable	The green turtle is globally distributed in tropical and sub-tropical waters, and is usually associated with shallow marine habitats that support seagrass and algal communities. Green turtles are known to feed on the seagrass in Moreton Bay. Feeding Areas Immature green turtles are carnivorous, while adults are generally herbivorous, feeding mostly on algae and seagrass. Adults will occasionally eat other items such as mangrove fruit, sponges and jellyfish. Adult green turtles typically forage in shallow benthic habitats, such as tidal and subtidal coral and rocky reefs and inshore seagrass beds and algae mats. Green turtles are known to feed on the seagrass in Moreton Bay. Breeding Areas	High - Moreton Bay supports feeding populations of green turtles. Green turtles often are observed in the seagrass beds adjacent to the proposed project. Green turtles are highly likely to occur in marine habitats within and adjacent to the Toondah Harbour,

Common Name	Species	EPBC Act Threatened Status	Ecology	Likelihood of Occurrence
			Green turtles nest on sandy beaches. In Queensland, southern green turtle populations typically nest around the Capricorn Bunker Groups and adjacent islands in the southern Great Barrier Reef, but also nest on islands of the outer edge of the reef. There are no key nesting areas in Moreton Bay; however, some turtles nest on the sandy beaches of the outer islands. Key Threats Key threats include commercial and recreational fishing, coastal infrastructure and development (including industrial, residential and tourism development), Indigenous harvest, feral animal predation, and climate change.	particularly in the seagrass beds.
Hawksbill Turtle	*Eretmochelys imbricate*	Vulnerable	The hawksbill turtle is globally distributed in tropical, sub-tropical and temperate waters. There is a small resident population of hawksbill turtles in Moreton Bay. Feeding Areas Hawksbill turtles are heavily reliant on coral reef and rocky habitats, where they forage mainly on sponges but also seagrass, algae, squid, gastropods, sea cucumbers, soft corals and jellyfish. As juveniles, they eat plankton. Feeding areas occur throughout eastern Queensland, from Torres Straight to Julian Rocks in northern New South Wales. Breeding Areas Hawksbill turtles nest on sandy beaches in the northern Great Barrier Reef and the Torres Strait. In Australia, the key nesting and inter-nesting areas include: ▪ Milman Island and the inner Great Barrier Reef Cays north from Cape Grenville Central ▪ Torres Strait islands ▪ Crab Island ▪ Murray Islands ▪ Darnley Island ▪ Woody Island ▪ Red Wallis and Woody Wallis Islands ▪ Bramble Cay and Johnson Islet (Torres Strait), and ▪ Western Cape York Peninsula (DEHP 2005). Migration Routes Hawksbill turtles that nest or forage on the east coast of Australia migrate to Indonesia, Papua New Guinea, the Solomon Islands, and Vanuatu.	Moderate - Despite not providing critical habitat, there is a small resident population of hawksbill turtles in Moreton Bay, and they may feed in, or traverse, the proposed project area. There is a moderate likelihood that hawksbill turtles occur in marine habitats within and adjacent to the Toondah Harbour project.

Common Name	Species	EPBC Act Threatened Status	Ecology	Likelihood of Occurrence
			Key Threats Key threats include commercial and recreational fishing, coastal infrastructure and development (including industrial, residential and tourism development), Indigenous harvest, feral animal predation, and climate change.	
Eastern Curlew	*Numenius madagascariensis*	Critically Endangered	Habitat and ecology In Australia, Eastern Curlew feeds during the low tide phase of the tide cycle on open intertidal mudflats or sandflats with relatively soft sediments with or without seagrass, and usually within 50 m of the low-water mark In Moreton Bay, the average summer density of feeding Eastern Curlews ranges between 3.7 and 71.9 birds per 100 ha of mudflat and is most strongly related to substrate resistance, with the birds preferring areas with softer sediments that they can more easily probe into to capture prey. During the high tide phase of the tidal cycle, Eastern Curlews roost in small to large flocks on sandy spits, sandbars, shallow lagoons, saltmarshes and claypans near the high-water mark. Migration Routes Migrating Eastern Curlews leave Moreton Bay over a period of about one month in March, but arrive back over a more extended period from August through to December; however 25% of Eastern Curlews in Moreton Bay do not migrate and remain through the austral winter. Most Eastern Curlews appear to migrate along the east coast of China and the Yellow Sea provides extremely important stopover feeding habitat for about 80% of the flyway population to replenish their fat reserves before continuing their migration. Key Threats Threats to Eastern Curlew in Australia include ongoing human disturbance at feeding and roost sites, habitat loss, habitat degradation from pollution, changes to the water regime and invasive plants. Key threats along their migration route are feeding habitat loss resulting from large land reclamation projects and habitat degradation resulting from aquaculture, gross pollution and invasion of salt marshes by exotic Spartina grass, particularly at key stopover migration staging sites in the Yellow Sea.	High - During the summer months October 2014 to February 2015, an average of 4.8 and maximum of 7 Eastern Curlew were recorded feeding on mudflats within the study area. Eastern Curlews were recorded roosting at the Nandeebie Claypan roost site.
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	Vulnerable	Habitat and ecology In Australia, Bar-tailed Godwits feed during the low tide phase of the tide cycle on open intertidal mudflats or sandflats with relatively soft sediments, usually foraging near the edge of the water or in shallow water. They feed on polychaete worms, molluscs, crustaceans and insects. In the highest quality feeding habitats on the eastern side of Moreton Bay, Bar-tailed Godwit feeding densities ranged between 3 and 8 birds per hectare of sandflat. During the high tide phase of the tidal cycle they roost in large flocks on sandy beaches, sandbars, spits	High - surveys identified an average of 24.8 and maximum of 36 Bar-tailed Godwits were recorded feeding on intertidal mudflats within the Toondah Harbour PDA. The feeding density recorded within the

Common Name	Species	EPBC Act Threatened Status	Ecology	Likelihood of Occurrence
			and in near-coastal saltmarsh. Bar-tailed Godwits have high fidelity to feeding and roosting sites in Moreton Bay, returning to the same feeding areas and roost sites both within and between seasons. Migration Routes Satellite tracking has shown that migrating Bar-tailed Godwits (western Alaska) leave Australia and New Zealand in March, making long flights (average 10,060 km) to staging sites in the Yellow Sea, where they stage for an average of 41 days to replenish their fat reserves before flying an average of 6,770 km to their breeding grounds. After completion of breeding, the birds stage for several weeks in southwest Alaska before either making non-stop flights across the Pacific Ocean to New Zealand (11,690 km in a complete track) or stopovers on islands in the south-western Pacific en route to New Zealand and eastern Australia. One satellite tracked bird made a non-stop flight of around 10,200 km in about eight days. After making these flights, the birds arrive starving on the staging sites; this highlights the critical importance of conserving sufficient intertidal feeding habitat in the staging areas to allow the birds to refuel. Threats The greatest threat facing Bar-tailed Godwits is habitat loss and degradation at key staging areas in the Yellow Sea, where about 80% of the East Asian-Australasian Flyway population stage on the northward migration. Other threats, including in Australia, include human disturbance at feeding and roosting sites, habitat loss and degradation from pollution, changes to the water regime and invasion of mudflats and coastal saltmarshes from the spread of mangroves.	study area (average 0.62 birds/ha, maximum 0.9 birds/ha) is substantially less that the densities of 3 to 8 birds/ha recorded in the highest quality feeding habitats on the eastern side of Moreton Bay. Bar-tailed Godwits were recorded roosting at the Nandeebie Claypan roost site (south of the existing ferry terminals, outside of the PDA) and at Oyster Point located 600 m from the PDA).
Great Knot	*Calidris tenuirostris*	Critically Endangered	Habitat and ecology In Australia, Great Knots feed during the low tide phase of the tide cycle on open intertidal mudflats or sandflats with relatively soft sediments, often feeding in flocks in shallow water at the mudflat/sandflat edge. Great Knots feed mostly on bivalve and gastropod molluscs, polychaete worms and Brachyura and Ostracoda crabs. During the high tide phase of the tidal cycle, Great Knots roost in often large flocks on sandy spits, sandbars, shallow lagoons, saltmarshes and claypans, often at the water's edge or in shallow water near the high-water mark. Migration Routes Most migrating Great Knots leave Australia from the north coast in March-April, flying directly to the Yellow Sea region of China and Korea, with a few to Japan, where they stage and spend time feeding to replenish their fat reserves before continuing their migration north to the	Moderate - During the low tide surveys, only a single Great Knot was recorded feeding on intertidal mudflats within the Toondah Harbour PDA on a single survey. The high tide survey results suggest that Great Knot occasionally roosts in relatively small numbers at the Nandeebie Claypan roost (south of the PDA) site as well as at the Oyster Point roost site located 600 m from the PDA.

Common Name	Species	EPBC Act Threatened Status	Ecology	Likelihood of Occurrence
			breeding grounds. After the breeding season, most adults congregate in the western and southern Sea of Okhotsk in south-eastern Russia, then fly direct to northern Australia, while some others move south to Korea before flying direct to Australia from there, arriving in late August to September. Key Threats The greatest threat facing the Great Knot is habitat loss and degradation at key staging areas in the Yellow Sea, which support about 80% of the East Asian-Australasian Flyway population on the northward migration. Great Knot is considered more vulnerable to reclamation activities than most other waders due to the very specific species and sizes of shellfish that they eat. Other threats include disturbance at feeding and roosting sites and the longer-term impact of climate change that is expected to reduce the area of intertidal feeding habitat.	
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered	Habitat and ecology Curlew Sandpipers feed in both tidal and non-tidal wetlands. In tidal wetlands they forage on mudflats, sandflats and nearby shallow water. In non-tidal wetlands they usually feed while wading through shallow water. In Australia, Curlew Sandpipers have a varied diet, but feed mostly on annelid worms, gastropod molluscs, crustaceans and insects. During the high tide phase of the tidal cycle, they roost in open areas with a damp substrate, including on sandy beaches, sandspits and islets in coastal lagoons and other wetlands. Migrations Routes Curlew Sandpipers start migrating north from their non-breeding sites in Australia between mid-January and mid-April, most of them migrating through southern China, where Bahai Bay is an important staging site, before they begin arriving on the breeding grounds in late May to early June. After the breeding season, returning birds reach the northern shores of Australia in late August and early September. However, substantial numbers of Curlew Sandpipers remain in northern Australia throughout the nonbreeding season. Threats Threats in Australia include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants.	Moderate - During the low tide surveys, Curlew Sandpiper was never recorded feeding on intertidal mudflats within the Toondah Harbour PDA. Furthermore, very few, if any, Curlew Sandpipers appear to use nearby mudflats. This suggests that feeding habitat within the PDA and nearby mudflats is of marginal importance to Curlew Sandpiper. The high tide survey results suggest that Curlew Sandpiper very rarely roosts at the Nandeebie Claypan roost site south of the PDA.
Koala	*Phascolarctos cinereus*	Vulnerable	Habitat and ecology: Koalas have a distinct association with eucalypt woodland and forest habitat types containing suitable food trees, particularly those growing on alluvial or other fertile soils. They are not necessarily restricted to bushland or remnant areas and are known to exist and	High - The initial field survey identified a total of 286 habitat trees important for Koala are scattered across the western portion of the PDA as a

Common Name	Species	EPBC Act Threatened Status	Ecology	Likelihood of Occurrence
			breed within farmland and the urban environment. Similarly, movement is not confined to vegetated corridors, as they also move across cleared rural land and through suburbs. They use a variety of trees, including many non-eucalypts, for feeding and resting. They do, however, have distinct, localised feeding preferences throughout their range, selecting some species in preference to others. Tree species preferences vary around Queensland; in the Redlands of south-east Queensland, the dominant diet species are Eucalyptus tereticornis (Hasegawa 1995) and E. microcorys (Tun 1993), whereas on North Stradbroke Island, Koalas prefer E. robusta (55% of diet), E. pilularis (13%), E. tereticornis (10%) and Lophostemon confertus (8%). <u>Threats</u> Current threats to Koalas include habitat destruction and fragmentation, bushfire and disease. Populations around urban areas are also at increased risk of mortality due to dog attack and vehicle strike.	component of the urban environment. Koala scats were observed under 33 of these trees, confirming recent Koala use of trees in the PDA, but no Koalas were observed. On later occasions, up to two Koalas were observed in habitat trees within the PDA, and up to three Koalas were observed in trees at Nandeebie Park south of the PDA.

Potential Impacts to Threatened and Migratory Species

The potential impacts of the Project on threatened and migratory species include the following:

- Direct impacts (reclamation areas) and indirect impacts to a small portion of the Moreton Bay Ramsar wetlands;
- Direct impact on an area of intertidal mudflats and sandflats that is recognised as important feeding habitat for migratory shorebirds, including known feeding habitat for two critically endangered and one vulnerable species;
- Indirect impacts on mudflats and sandflats adjacent to the PDA that are recognised as important feeding habitat for migratory shorebirds; indirect impacts relate to reduced food availability for migratory shorebirds in intertidal mudflats and sandflats adjacent to the PDA in the event that altered water quality or hydrodynamics affect benthic invertebrate abundance in intertidal mudflats and sandflats adjacent to the PDA;
- Increased disturbance to migratory shorebirds roosting at three important roost sites for migratory shorebirds located close to the Project, including roosts known to be used by three critically endangered and one vulnerable species (see further detail below). Increased disturbance has potential to lead to a substantial reduction in the use of the roost sites by migratory shorebirds;
- Increased disturbance to migratory shorebirds feeding on intertidal mudflats and sandflats adjacent to the PDA in the event that the Project facilitates greater pedestrian access to these areas at low tide, particularly the areas to the east of the Cassim Island mangroves that might be attractive to recreational walkers with dogs;
- Short term disturbance of sediments and soil (increasing turbidity, suspended solids, sedimentation, nutrients, contaminants and potential acid sulfate soils) during construction periods. Many fish and marine megafauna (e.g. dolphins, turtles and dugongs) are likely to avoid areas of high turbidity and suspended solids;
- Short term disturbance through increased noise and vibration during construction periods;
- Altered hydrodynamics;
- Increased site access and boating;
- Loss of food trees used by several individuals of the vulnerable Koala in an urban area that is not recognised as 'habitat critical to the survival of Koala';
- Risk of mortality of Koalas during clearing of Koala habitat trees prior to construction; and
- Increased risk of mortality to the vulnerable Koala due to increased vehicle traffic and dog ownership resulting from increased urbanisation.

Potential Impacts to Migratory Shorebirds

Potential direct impacts relate to the clearing of habitat or vegetation associated with the reclamations and dredging associated with harbour and navigational upgrades and new wet berths and marine facilities. The loss of important intertidal feeding habitat for migratory shorebirds, including for threatened species, could be expected to lead to a corresponding decrease in the number of migratory shorebirds using the Moreton Bay Ramsar Wetland proportional to the loss of habitat if migratory shorebird populations in Moreton Bay were currently subject to density-dependent population regulation.

However, migratory shorebird populations using Moreton Bay have undergone substantial declines in recent years due to factors outside of Moreton Bay. This suggests the carrying capacity of the Moreton Bay wetlands for supporting migratory shorebirds is currently likely to be underutilised (i.e. migratory shorebirds are not subject to

density-dependent population regulation due to the substantial loss of birds from the system as a result of declining numbers year on year mainly associated with disruption in other parts of the flyway). This underutilisation is likely a result of factors outside Moreton Bay, in particular impacts to coastal mudflats in the Yellow Sea. A recent study carried out by Studds *et al* (2017) found "*Yellow Sea reliance was the single most important predictor of variation in population trends*" and that "*Population trends were strongly negatively related with Yellow Sea reliance*". As a result, the loss of a relatively small area of intertidal feeding habitat (approximately 0.007% of intertidal mudflats within Moreton Bay – refer to **Attachment 3** of this referral) may not lead to a corresponding reduction in the number of migratory shorebirds using Moreton Bay.

Indirect impacts to migratory shorebirds include increased disturbance while utilising the roost sites. The development has the potential to increase disturbance to migratory shorebirds roosting in the mangroves of the Cassim Island roost site as a result of:

- Presence of built infrastructure and human activities closer to the roost site than at present;
- Increased noise, particularly during Project construction and pile driving;
- Increased lighting of the roost site at night from Project lighting;
- General project construction activities;
- Increased use of the waters within and adjacent to the roost by kayakers at high tide in the event that the Project provides launching points for kayakers; and
- Increased use of the waters within and adjacent to the roost by small recreational boats at high tide resulting from increased recreational boat traffic at Toondah Harbour.

Indirect impacts may include increased disturbance to migratory shorebirds roosting at the Nandeebie Claypan and Oyster Point roost sites (which are external to the Site) may result from:

- Increased pedestrian and cyclist traffic along the existing public walkway adjacent to the Nandeebie Claypan that increases the risk of people and dogs leaving the walkway to enter the roost site; and
- Increased recreational use of Oyster Point, where recreational activities already cause substantial disturbance to roosting shorebirds.

Potential Impacts to other Marine Fauna

The project is unlikely to result in direct impacts to marine fauna however increased human activity during construction, including changes in underwater noise levels, may affect the behaviour of fauna, particularly marine mammals.

Underwater noise and other loud sounds may affect marine mammals by interfering with their use of sounds in communication, especially in relation to navigation and reproduction. Marine mammals cease feeding, resting or social interaction at the onset of acoustic disturbance and to initiate alertness or avoidance behaviours. Marine mammals in the vicinity of frequent, high intensity noise are likely to be highly stressed or even physically harmed and consequently, are likely to stay well away from continuously operating acoustic disturbance. Therefore, any Indo-Pacific humpback dolphins, bottlenose dolphins or dugongs in the vicinity of the proposed development may vacate the area on commencement of the proposed in-water works such as wet excavation. Noise from on-land works is unlikely to disturb marine mammals. Any avoidance behaviour is likely to cease following completion of the work

Turtles have relatively poor hearing and are far less likely to be impacted by underwater acoustic disturbance. In the unlikely event that underwater construction does audibly disturb turtles, they may temporarily leave the area.

Fish, turtles and marine mammals may also become trapped in excavation areas during dredging and reclamation works. Impact to these marine fauna will depend on the time taken to excavate and the turbidity of the water during excavation, with higher turbidity and longer periods more likely to negatively impact marine fauna. A number of management measures will be put in place to reduce the risk of impact to fauna including the use of temporary barriers and visual monitoring.

Operational Impacts

Once construction has been completed and residential and tourism uses (including the marina) commence there is the potential for ongoing impacts to threatened and migratory species. The actions with the most potential to cause ongoing impacts include:

- An increase in boating traffic and other recreational uses such as kayaking in and around the project area;
- An increase in lighting and noise associated with ongoing uses; and
- Ongoing maintenance dredging of the harbour, marina and entrance channel.

Moreton Bay is adjacent to the most populated region in Queensland and already subject to significant boat traffic and recreational use. Toondah Harbour is an existing boat harbour including multiple ferry terminals and a public boat ramp. The proposed development is unlikely to result in an overall increase in recreational uses in Moreton Bay, but may result in an intensification of use around the site.

The proposed development may result in an increase in daily boat trips in the immediate area which could result in additional risk of boat strike for marine fauna, in particular dugongs and turtles which risk injury when coming to the water surface for air. There are a number of 'go slow' areas located in turtle and dugong hotspots throughout the Moreton Bay Marine Park. However, these areas are generally located around the bay islands, in particular North Stradbroke Island, with none located near Toondah Harbour.

Although the statutory plan for the PDA allows up to 400 marina berths, the proponent recognises the increased risk of boat strike to marine fauna from recreational vessels, and has reduced the number of proposed marina berths to approximately 200. Mandating sealife friendly propellers for vessels using the marina is also under consideration as an innovative response to minimising injury should marine fauna be subject to vessel strike.

While lighting and noise may increase compared to existing conditions at the site, which has the potential to cause disturbance to shorebirds, a minimum 250m buffer has been proposed between development and Cassim Island and Nandeebie Claypan high tide roost sites. This exceeds best practice requirements to avoid impacts on migratory species. The concept master plan for the development has been amended to ensure that most intensive human activities are conducted in areas furthest from the roost sites. Sympathetic lighting strategies, vegetation screening and sound attenuation will also be incorporated during detailed design to ensure impacts are avoided and minimised.

Overall potential impacts to migratory birds and marine fauna can be managed through increased management of the site and surrounds, educational tools and awareness raising. A range of measures have been identified that will assist to minimise, mitigate and offset potential impacts to migratory birds and marine fauna, which will be explored in detail through the EIS process. This includes:

- Increased management of the local area through a community ranger program
- Wetland education and cultural entre
- Community awareness campaigns
- Educational signage, in particular in areas surrounding high tide roost sites.

Toondah Harbour and the 2.55km entrance channel is already subject to periodic maintenance dredging by the state government and impacts would not be expected to be significantly different to what currently occurs. It is of note that impacts from previous maintenance dredging campaigns are considered to be minor and have not previously required referral under the EPBC Act. All options for treatment and disposal of dredge spoil from maintenance dredging will be examined through the EIS process.

Significant Impacts to MNES

To assist proponents to determine if their proposed action is likely to have a significant impact on matters of national environmental significance (MNES), the Commonwealth Government produced a series of guidelines on significant impacts. Most relevant for Ramsar wetlands are the *Significant Impact Guidelines 1.1 Matters of National Environmental Significance* (CoA 2013). These guidelines state that:

An action is likely to have a significant impact on a threatened species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population (or any population for endangered and critically endangered species);
- reduce the area of occupancy of an important population (or the species in general for endangered and critically endangered species);
- fragment an existing important population into two or more populations (or any population or endangered and critically endangered species);
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population (or any population for endangered and critically endangered species);
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- 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;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

While management measures will be put in place to mitigate any indirect impacts to threatened species (see below), the removal of an area of low tide feeding habitat has some potential to reduce the area of occupancy for endangered and critically endangered species and/or disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species (defined at a national level as 0.1% of the estimated national population of the species, and at an international level as 1% of the population of the species).

While Moreton Bay's carrying capacity of migratory shorebirds and marine fauna species is unlikely to be affected the project will be referred as a controlled action to allow more detailed assessment under the EPBC Act to be carried out. It is noted that once projects are within a controlled action process offsets and benefits associated the project can be considered.

Management Measures

A number of management measures will be put in place through the design, construction and ongoing use of the Toondah Harbour project to avoid potential impacts on MNES. Some of the key management measures are outlined below however it is noted these will be refined and added to over the course of the assessment process.

Migratory Shorebirds

The project will be designed and managed to avoid any permanent impact on high tide roosting sites through the use of buffer areas and a number of other measures including:

- construction of appropriate barriers, such as fences to restrict access; ideally, there should be no public access (by humans and/or domestic animals) to areas identified as important to migratory shorebirds;
- landscape and urban design to include sympathetic lighting strategies, vegetation screening and sound attenuation; and
- increased community education through mechanisms such as educational programs delivered through proposed wetland education and cultural centre, and interpretive signs at access points to shorebird habitats.

The implementation of a buffer zone around the Cassim Island shorebird roost site will likely be critical to mitigating potential impacts on this important roost site. A buffer of approximately 250 m from any urban development to the outer edge of the core roost site would keep disturbance to roosting shorebirds to a minimum.

In the event that the Project provides launch points for kayakers, implementation of a buffer exclusion zone, with no public access to the roost site, would be critical for mitigating disturbance to roosting shorebirds. Effective implementation of such a buffer exclusion zone would require interpretative signage specific to the Cassim Island roost site to be placed at shoreline entry points as well as sufficient resources to regularly enforce the exclusion zone over the long term. It is noted that kayakers and small motorised vessels such as jet skis already launch from the boat ramp at Toondah Harbour therefore exclusion zones and educational signage would result in an improvement to the current situation at Cassim Island.

The impact of disturbance from general Project construction activities, particularly activities such as dredging and pile driving near sensitive areas, can be mitigated by timing these activities to occur over the winter months May to August when most migratory shorebirds are absent from Moreton Bay. Construction will be staged over several years therefore works can also be staged to ensure impacts are minimised.

The maintenance of tall mangrove vegetation between the north-western edge of the roost site and the Project footprint would assist with screening the roost site from Project infrastructure and construction and operational activities. Construction of a barrier fence and vegetation screening along the boundary of the public walkway adjoining the Nandeebie Claypan roost site, together with site-specific information signs erected along the barrier fence would help minimise the risk of public and dog access to the Nandeebie Claypan roost site. The suitability of the Nandeebie Claypan roost site for migratory shorebirds could be enhanced though control of mangroves that are slowly encroaching on the roost site, particularly along the eastern boundary of the roost site.

Other Marine Fauna

Management measures will be put in place during construction activities to minimise the temporary impacts to water quality outside of the project footprint. Specific measures may include:

- designing the project to minimise the area of sediment and / or soils being disturbed;
- using temporary enclosures (complete enclosures such as sheet piles or alternate enclosures such as silt curtains) to reduce the intensity and spatial distribution of potential impacts;
- isolating the disturbance areas, for example by using sheet piles, silt curtains, oil spill booms, bunding, trenching and / or similar technologies;
- identifying and managing acid sulfate soils and other contaminants, through a sediment sampling and analyses plan (SAP) in accordance with the National Assessment Guidelines for Dredging 2009;
- developing thresholds for turbidity and suspended solids, and appropriate management (e.g. triggers for ceasing works) for seagrass and corals and monitoring water quality during construction; and
- monitoring changes in seagrass and coral communities post-construction to determine any potential impacts.

The risk of impacts to marine fauna as a result of noise and boat strike will be reduced further by preparing a Fauna Management Plan. Measures to minimise potential impacts to marine fauna may include:

- where dredging or pile driving activities are occurring, every morning before works begin, or after works have ceased for more than two hours and prior to it beginning again, appropriately trained Marine Fauna Observers (MFOs) inspect the area around all pile driving activities for 30 minutes;
- all vessel crew maintaining a look out for marine mammals and turtles during all operations;
- if prior to works, a marine mammal or turtle is identified within 150 metres, then pile driving does not commence until the animal has passed;
- if after works have commenced (including a soft start phase), a marine mammal or sea turtle is observed within 100 m of the noise emitting source, then pile driving ceases until the animal has passed;
- if a marine mammal or turtle are sighted in the pre-defined observation and exclusion zones, project vessels operating in the area are notified and piling ceases until the animal has passed;
- have a 'soft-start' for all pile driving, slowly increasing intensity of the driving hammer power;
- site inductions for all vessel crew covering procedures to minimise disturbance to marine fauna;
- training of all vessel crew in the identification of marine mammals and turtles;
- routine maintenance and inspection of all noise-generating equipment (including vessel engines, drill and piling equipment) to reduce unnecessary increases in noise levels from the equipment;
- where practical, engines, thrusters and auxiliary plant are not left on standby or running mode; and
- adherence to speed limits of all vessels involved in construction.

Marine pest species can be introduced via ballast water and hull fouling. While this risk is predominantly from vessels that have been in international waters, there is also a risk of boats spreading pests established in other ports. The introduction and spread of marine pest species can be minimised by following protocols of the National System for the Prevention and Management of Marine Pest Incursions, which aims to prevent new marine pests from arriving in Australia, and minimize the spread of pests within Australian waters. To reduce the risk of inadvertently spreading marine biofouling pests, vessel operators need to minimise the amount of biofouling on their vessels (Australian Government 2010).

Increased usage of the shoreline may lead to an increase in weed cover in mangrove and saltmarshes. This may be a result of dumping of garden refuse, by seeds and propagules being inadvertently spread along access tracks and

paths by vehicles or on foot, and by the air and water borne spread of seeds and propagules from gardens and landscaped areas.

A weed management plan, and a strategy for the maintenance of native plant areas on the proposed site would reduce this risk of introduced plant pests.

Koala

The potential impacts of the Project on Koalas that currently utilise feed trees within the PDA can be mitigated by:

- adopting a landscape and urban design that retains as many of the primary food trees as possible;
- planting additional primary Koala food trees both within the PDA and surrounding areas where possible, to mitigate the potential loss of a small number of Koala food trees within the PDA. Planting of trees in advance of impacts will be considered noting that it will take years for the plantings to reach a size that they begin to provide food for Koalas;
- including traffic calming designs for roads crossing the open space corridor, and implementing a maximum speed limit of 40 km/hr;
- ensuring that the clearing of any trees during Project construction is performed under the guidance of a licenced fauna spotter; and
- using Koala exclusion fencing to fence off areas that may pose a risk of injury to Koala during construction.