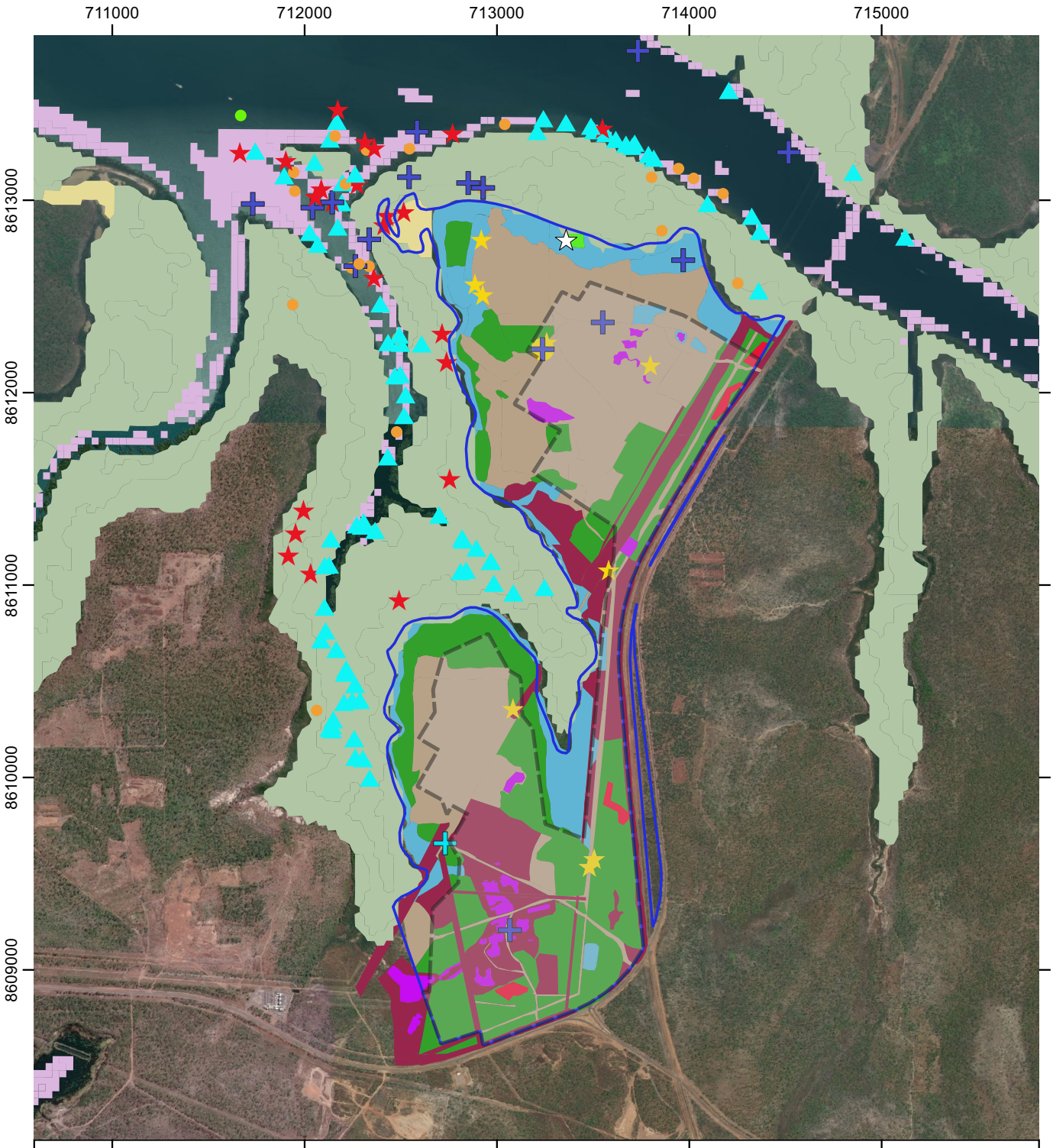


Figure 3-20. Fauna habitats and location of conservation significant fauna records

Significant fauna
- Black-footed Tree-rat
- Common Greenshank
- Common Sandpiper
- Eastern Curlew
- Eastern Osprey
- Fork-tailed Swift
- Greater Sand Plover
- Little Tern
- Oriental Cuckoo
- Pale Field-rat
- Whimbrel

Terrestrial habitats
- Disturbed areas
- Eucalyptus woodland
- Melaleuca woodland
- Monsoon Closed Forest
- Native Grasslands
- Temporary Water Bodies
- Significant Vegetation - Large Trees
- Lot 1817 boundary
- EIS Supplement Development Envelope

Shorebird habitats
- Mangrove
- Saltpan
- Intertidal layer

0 500 1000 m

eleanor@animalplantmineral.com.au
date: 20/01/2021
GDA94 MGA Zone 52
basemap: ESRI

The value of the habitats present in the Study Area is scored based upon the importance for Significant species and is listed in **Table 3-3**.

Table 3-3. Value of habitats in the Study Area

Habitat	Habitat value score	Reason for significance
Mangroves	High	• Roosting and feeding habitat for Eastern Curlew, Whimbrel, Common Sandpiper, Common Greenshank, Little Tern, Oriental Cuckoo • Potential feeding habitat for the Bar-tailed Godwit
Saltpan	High	• Roosting habitat for Eastern Curlew • Potential roosting habitat for the Greater Sand Plover and Bar-tailed Godwit
Mudflats	High	• Feeding habitat for Eastern Curlew, Greater Sand Plover, Whimbrel, Common Sandpiper, Oriental Cuckoo • Potential feeding habitat for all migratory shorebirds present in the Darwin Harbour including the Great Knot, Red Knot, Lesser Sand Plover and Bar-tailed Godwit.
Mixed Woodland	High	• Contains 3.7 ha of NT significant vegetation of large trees • Confirmed foraging, breeding, resting habitat for Black-footed Tree-rat • Foraging habitat for the Oriental Cuckoo • Suitable habitat for the Eastern Osprey • Potential Northern Quoll and Yellow Spotted Monitor and Fawn Antechinus foraging habitat
Melaleuca Woodland	Low	• Fork-tailed Swift -foraging • Howard River Toadlet – unconfirmed habitat • Eastern Osprey foraging, breeding, resting habitat
Monsoon closed forest	Moderate	• NT Significant vegetation • Confirmed foraging, breeding, resting habitat for Pale Field Rat
Native grasslands	Low	• A large proportion of this habitat is Degraded or completely degraded by former sand mining activity • No significant fauna as defined in Section 1.3 recorded in this habitat • Potential Yellow spotted monitor foraging habitat
Temporary water bodies	Low	• This habitat is Degraded or completely degraded by former sand mining activity • This habitat is suitable breeding habitat for the introduced Cane Toad (*Rhinella marina*). • No significant fauna as defined in Section 1.3 recorded in this habitat • Potential Mertens' Water Monitor foraging habitat
Disturbed areas	Low	• This habitat is Degraded or completely degraded by former sand mining activity • No significant fauna as defined in Section 1.3 recorded in this habitat • Black-footed Tree-rat was recorded in this habitat type however it is likely to have been travelling between habitat patches (Rankmore 2006).

The Mangroves, Saltpan and Intertidal mudflats are considered to be significant as they provide habitat for migratory shorebirds including the Eastern Curlew. The Eastern Curlew has been recorded roosting at the saltpan habitat within Lot 1817.

The Mixed Woodland are considered to be significant as they provide habitat to the Black-footed Tree-rat and Pale Field Rat. Both species have been recorded within Lot 1817. This habitat type is also suitable for the Northern Quoll, however the species has not been recorded within Lot 1817. The Mixed woodland contains 3.7 ha of significant habitat as defined under the NT Land Clearing Guidelines as it has the requisite density of trees ≥ 50 cm in diameter that have the potential to provide tree hollows. The remainder of the woodland trees are of smaller diameter and are unlikely to provide significant habitat for species that require hollows.

3.5 HABITAT FEATURES

3.5.1 Sensitive and Significant Vegetation

Sensitive and significant vegetation are defined by the Northern Territory Land Clearing Guidelines (DENR 2019). Sensitive vegetation is a term applied to ecosystems easily impacted by neighbouring or adjacent land uses or management. Significant vegetation also includes spatially restricted habitat types that are important to a relatively large number of wildlife species including rainforest, monsoon vine forest or vine thicket; sandsheet heath; riparian vegetation; mangroves; and vegetation containing large trees with hollows suitable for fauna.

Sensitive and/or significant vegetation types that occur within the Study Area are:

- Vegetation containing large trees with the threshold value of large trees (≥ 50 cm diameter at breast height). This is 3.7 ha of land within the Mixed Woodland habitat type
- Monsoon Closed Forest
- Riparian vegetation (*i.e*. Melaleuca woodland), and
- Mangroves

Areas of seasonal inundation occur in the Study Area; however, these are entirely previously disturbed through use as a quarry. The removal of the upper layers of the soil profile have resulted in a low topographic area that receives seasonal runoff. Due to the disturbance history it is not considered here to be sensitive or significant vegetation.

Ordinarily, sensitive and significant vegetation has a requirement for a 250 m buffer under the Land Clearing Guidelines. In most instances within the Study Area, previous activities have resulted in disturbance of these buffer zones.

3.5.2 Remnant Mixed Woodland

The remnant Mixed Woodland is habitat to the Black-footed Tree-Rat. The remnant patches at Lot 1817 are currently fragmented by disturbed areas. The disturbed areas currently pose a risk to the quality of these habitats as they increase the likelihood of uncontrolled fire due to the high grassy weed load and the nature of human disturbance (often cars are dumped and set on fire), and the suitability for invasive fauna that are commonly recorded there.

3.5.3 Waterbird Aggregations

Section 4.2.2 of the Terms of Reference indicates the Environmental Impact Assessment for the Project must include an assessment of all the relevant risks of the Project to nationally significant aggregations of waterbirds.

Under the EPBC Act, 'important habitat' is a key concept for migratory species, as identified in EPBC Act *Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance 2009*. Defining this term for migratory shorebirds in Australia is important to ensure that habitat necessary for the ongoing survival of migratory species is appropriately managed (CoA 2017).

Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. The widely accepted and applied approach to identifying internationally important shorebird habitat throughout the world has been through the use of criteria adopted under the Ramsar Convention.

According to this approach, wetland habitat should be considered internationally important if it regularly supports:

- one percent of the individuals in a population of one species or subspecies of waterbird; or
- a total abundance of at least 20,000 waterbirds.

Nationally important habitat for migratory shorebirds is defined using a similar approach to these international criteria, *i.e*. if it regularly supports:

- 0.1 % of the flyway population of a single species of migratory shorebird; or
- 2,000 migratory shorebirds; or
- 15 migratory shorebird species.

3.5.3.1 Significance of Waterbird Abundance and Diversity

Determining the significance of waterbird abundance and diversity has definitional challenges as surveys conducted to record these variables are inconsistent in the size of the areas where records are made, the timeframes records are collected over, the seasonal or tide cycle conditions at the time of survey and the frequency or currency of the recording (Chatto 2000; Chatto 2006, Chatto 2012; DENR 2019; Hansen *et al* 2016; Lilleyman *et al* 2018, 2020a, 2020b;).

Shorebird monitoring occurs across six sites in the Greater Darwin area. Surveys at East Point, Spot on Marine, Nightcliff, Sandy Creek and Lee Point-Buffalo Creek (**Figure 3-21**) have been conducted by Chatto (2012) in 1996, 2010 and 2011 and there has also been a regular monitoring program conducted by BirdLife Australia since 2010. These sites are outside Darwin Harbour Proper (Lilleyman and Garnett 2019, **Figure 3-21**) and have different habitat availability than is present within Darwin Harbour Proper. A study of movements among and between sites (A. Lilleyman, D. Rogers, G. O'Brien, S. Garnett, unpubl. Data cited in Lilleyman *et al*. 2020a) showed that the birds roosting at the network of sites between East Point and Lee Point/Buffalo Creek and birds roosting at East Arm Wharf constituted two separate subpopulations within Darwin Harbour. These sites are included in the assessments made by Chatto (2000, 2006) for the Greater Darwin area that were used to assess site significance in the Species Profile and Threats (**SPRAT**) Database. East Arm Wharf is an artificial site within Darwin Harbour Proper and has been systematically surveyed since 2013. Records within the NT Fauna Atlas (DENR 2019) are haphazard records across many sources and many years – some records dating back to the turn of the century and transcribed from historic sources. Lilleyman *et al*. (2018) aerially surveyed Darwin Harbour Proper at a Spring high tide, however a planned repeated survey in 2020 was unable to replicate tidal conditions due to climatic conditions (Lilleyman *et al*. 2020b). In addition, the frequent repeated sampling in set locations demonstrates high variability in numbers over time (Lilleyman and Garnett 2019; Lilleyman *et al* 2020a, 2020b) and population

decline is generally attributed to habitat pressures outside of Australia. Consequently, there are a number of inconsistent determinations and interpretations around the significance or otherwise of aggregations in the Darwin Harbour Proper.

The most recent analysis reports twenty six species of migratory shorebird that have been regularly recorded across the Darwin Harbour region, and a further species, the Ruff (*Calidris pugnax*) which has recently been recorded in the region (Lilleyman & Garnett, 2019). Of the regularly recorded shorebird species, seven are listed threatened species under the EPBC Act. All species are listed under international conventions and bilateral agreements. **Table 2-1** lists the migratory shorebirds regularly recorded in the Darwin Harbour and their conservation status under the EPBC Act. These species are all considered MNES.

Chatto (2012) reports total migratory shorebird numbers in the Greater Darwin area, specifically between Lee Point and Tree Point, 18.5 km northwest of the Project (**Figure 3-21**), as 3500 in 1996, 14297 in 2010 and 9230 in 2011. This area qualifies as a Nationally significant aggregation of waterbirds for total population size.

Lilleyman *et al*. (2018) surveyed the Darwin Harbour Proper for migratory shorebirds in January 2017 and recorded 724 birds of 19 species during the low tidal survey and 789 birds from 13 species recorded during the high tidal survey with a total of 24 species for the day. A repeated survey recorded 1134 birds from 31 species during the low tide aerial survey and 975 birds from 22 species during the high tide aerial survey in January 2020 (Lilleyman *et al* 2020b). Unpublished data suggests a low level of movement between Darwin Harbour Proper and the Lee Point to Tree Point area (cited in Lilleyman *et al*. 2020b). Whilst this count does not meet the threshold requirement for abundance it does meet the threshold value for diversity and as such the work conducted by Lilleyman *et al*. (2018; 2020b) qualifies the Darwin Harbour Proper as a nationally significant aggregation of waterbirds for diversity.

A significant amount of survey work has been conducted at the East Arm Wharf where the expansion project in 2011 required the protection and maintenance of Pond "D" as a suitable high tide roost habitat (Garnett 2012). Baseline surveys conducted at East Arm Wharf recorded the largest number of migratory shorebird observations as 1918 sightings (Ecological Management Services 2011). During the surveys, migratory shorebird numbers at East Arm Wharf met the criteria for supporting nationally important migratory shorebird habitat in that 17 species were recorded on a specific location within the East Arm Wharf, namely Pond D.

Surveys conducted at the Middle Arm of Darwin Harbour over the November 2019 – January 2020 period (Lilleyman *et al*. 2020b) recorded the intertidal mudflat between Blaydin Point (Inpex operations) and Darwin LNG plant as supporting large congregations of shorebirds during low tide. At high tide, the mangrove and saltmarsh between Bladin Point and the Elizabeth River bridge supported large congregations of birds, predominantly migratory but not threatened species (Lilleyman *et al* 2020b, **Figure 3-21**). The counts did not identify a total number of migratory shorebirds that would qualify for a nationally significant aggregation, but the Middle Arm does qualify as a nationally significant aggregation on the basis of diversity.

Due to the differences in scale and approach taken by the various survey efforts the notion of Nationally Important habitat for waterbird species based on abundance and/or diversity can be applied to the Greater Darwin area including the Darwin Harbour Proper, and also the specific locations of Middle Arm, the Lee Point to Tree Point and the East Arm Wharf (including Pond D).

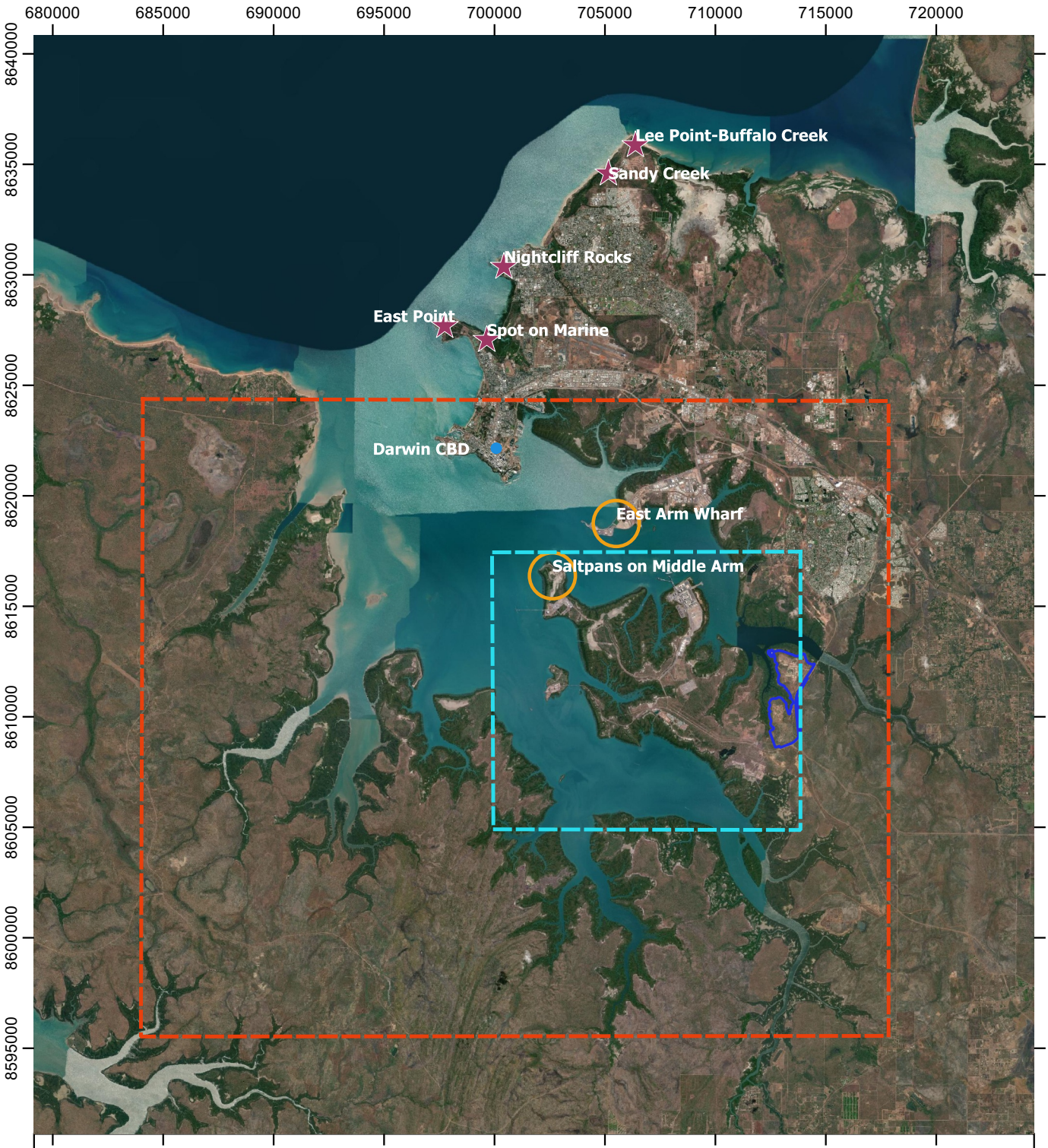


Figure 3-21. Sites of Significant Aggregations of migratory shorebirds in the Greater Darwin Region

Legend

- Spring Tide Roosting Habitat
- Northern Beaches
- Darwin Harbour Proper
- Middle Arm
- Lot 1817 boundary

0 2.5 5 km

date: 22/01/2021
CRS: GDA94 MGA Zone 52
basemap: ESRI

3.5.3.2 Significance of Individual Species

A total of 37 species of migratory shorebird are known to regularly visit Australia, of which 26 occur along the coastlines of Darwin Harbour (Lilleyman *et al*., 2019).

The importance of the local population in a local, regional, territory, national and international context is addressed for each species in **Table 3-4**. **Table 3-4** lists the population estimates for migratory shorebirds in the Northern Territory, Australia, EAAF, and sites of national or international significance in the Darwin Harbour.

In an analysis of survey data collected from the East Point to Lee Point/Buffalo Creek within the Greater Darwin area from 1980 to 2018 Lilleyman *et al*. (2020a Supplement) find the habitat network met the threshold for national importance for 9 species based on the maximum count for each species across the network; The Lee Point roost site regularly met the threshold for international importance for Great Knot (*Calidris tenuirostris*) throughout most of the summer season, while Greater Sand Plover (*Charadrius leschenaultii*) and Black-tailed Godwit (*Limosa lapponica*) were recorded in internationally important numbers on one occasion at this site (**Table 3-4**).

Garrett (2012) notes that at the East Arm Wharf three migratory shorebird species - Lesser Sand Plover, Greater Sand Plover, and Far Eastern Curlew - were recorded at numbers qualifying for nationally significant aggregation, each on a single occasion and an independent set of 30 counts carried out on behalf of the Darwin Port Corporation (**DPC**) recorded Far Eastern Curlew at numbers qualifying for nationally significant aggregation on two occasions.

In an analysis of survey data collected at East Arm Wharf over the period 2010-2018 Lilleyman *et al*. (2020a Supplement) found 9 species exceeded the threshold for nationally important aggregation at least once (**Table 3-4**). The 329 birds recorded by Lilleyman *et al*. (2018) in the Darwin Harbour Proper is approaching the value required for recognition as an Internationally Important Aggregation of Far Eastern Curlew (350 birds).

Surveys conducted at the Middle Arm of Darwin Harbour over November to December 2019 (Lilleyman *et al*. 2020b) recorded four species of migratory shorebird that had maximum counts exceeding the threshold for Nationally Significant aggregations (Grey-tailed Tattler, Terek Sandpiper, Whimbrel and Far Eastern Curlew).

Table 3-4. Population estimates for migratory shorebirds in the Northern Territory (NT), Australia, and the East Asian-Australasian Flyway (EAAF), and sites of significance in the Greater Darwin region

Shorebird	Scientific name	Significant sites (max count)	NT population[a]	Australian population[b]	EAAF population[b] (1 % pop.; 0.1 % pop.)
Common Sandpiper	*Actitis hypoleucos*		180	2,501	190,000 (1,900; 190)
Ruddy Turnstone	***Arenaria interpres***	**East Point to Lee Point (≈62)[c]**	5,000	20,800	30,000 (300; 30)
Sharp-tailed Sandpiper	***Calidris acuminata***	**East Arm Wharf (≈220) [c]**	20,100	85,809	85,000 (850; 85)
Sanderling	***Calidris alba***	**East Point to Lee Point (≈180)[c]**	890	15,082	30,000 (300; 30)
Red Knot	*Calidris canutus*		24,200	68,927	110,000 (1,100; 110)
Curlew Sandpiper	*Calidris ferruginea*		17,800	45,485	90,000 (900; 90)
Red-necked Stint	*Calidris ruficollis*		44,400	389,206	475,000 (4,750; 475)
Long-toed Stint	*Calidris subminuta*		100[b]	553	230,000 (2,300; 230)
Great Knot	***Calidris tenuirostris***	**†Lee Point (8000)[c]**	122,000	381,854	425,000 (4,250; 425)
Little Ringed Plover	*Charadrius dubius*		20[b]	10	150,000 (1,500; 150)
Greater Sand Plover	***Charadrius leschenaultii***	**†Lee Point (2000)[c]** **East Arm Wharf (≈530) [c]** **Greater Darwin area (1,024)[a]**	40,300	126,616	200,000 – 300,000 (2,000; 200)
Lesser Sand Plover	***Charadrius mongolus***	**East Arm Wharf (≈280) [c]** **Greater Darwin area (1,440)[a]**	39,000	27,551	180,000 – 275,000 (1,800; 180)
Oriental Plover	*Charadrius veredus*		130	232,124	230,000 (2,300; 230)

Shorebird	Scientific name	Significant sites (max count)	NT population[a]	Australian population[b]	EAAF population[b] (1 % pop.; 0.1 % pop.)
Asian Dowitcher	*Limnodromus semipalmatus*		190	473	14,000 (140; 14)
Bar-tailed Godwit	*Limosa lapponica*		53,000	189,146	325,000 (3,250; 325)
Black-tailed Godwit	***Limosa limosa***	**†Lee Point (1600)[c]**	44,000	50,508	160,000 (1,600; 160)
Far Eastern Curlew	***Numenius madagascariensis***	**East Arm Wharf (≈280) [c]** **Darwin Harbour Proper (329)[d]** **Darwin Harbour Middle Arm (102)[e]**	6,800	26,405	35,000 (350; 35)
Little Curlew	*Numenius minutus*		12,500	76,908	110,000 (1,100; 110)
Whimbrel	***Numenius phaeopus***	**East Point to Lee Point (≈100)[c]** **East Arm Wharf (≈400) [c]** **Darwin Harbour Middle Arm (77)[e]**	5,100	24,972	65,000 (650; 65)
Pacific Golden Plover	***Pluvialis fulva***	**East Arm Wharf (≈145) [c]**	200	9,091	120,000 (1,200; 120)
Grey Plover	***Pluvialis squatarola***	**East Point to Lee Point (≈160)[c]**	5,400	12,120	80,000 (800; 80)
Grey-tailed Tattler	***Tringa brevipes***	**East Point to Lee Point (≈75)[c]** **East Arm Wharf (≈410) [c]** **Darwin Harbour Middle Arm (101)[e]**	16,000	64,360	70,000 (700; 70)
Wood Sandpiper	*Tringa glareola*		40	1,790	130,000 (1,300; 130)
Common Greenshank	***Tringa nebularia***	**East Arm Wharf (150)[c]**	7,600	27,463	110,000 (1,100; 110)
Marsh Sandpiper	*Tringa stagnatilis*		12,100	53,481	130,000 (1,300; 130)

Shorebird	Scientific name	Significant sites (max count)	NT population[a]	Australian population[b]	EAAF population[b] (1 % pop.; 0.1 % pop.)
Terek Sandpiper	***Xenus cinereus***	**East Point to Lee Point (≈64)[c]** **East Arm Wharf (≈280) [c]** **Darwin Harbour Middle Arm (100)[e]**	15,000	19,115	50,000 (500; 50)

[a] Chatto, 2003; [b] Hansen *et al*., 2016; [c] Lilleyman *et al* (2020a), [d]Lilleyman *et al*. (2018), [e]Lilleyman *et al*. (2020b).
Internationally significant (1 % EAAF pop.) and nationally significant (0.1 % EAAF pop.) population estimates are presented in brackets.
Species with a nationally or internationally significant site in the Greater Darwin region based upon maximum count data are presented in bold.
† Internationally significant.
≈ approximately.

3.5.3.3 Identification of Suitable Habitat

Recent studies of Darwin Harbour have identified shorebirds using a wide range of areas for roosting and foraging (Lilleyman *et al*., 2018). Individual birds have been shown to use large areas of the Darwin Harbour over the tide cycle to accommodate feeding and roosting requirements (Lilleyman & Garnett, 2019). Migratory shorebirds require a range of roosting and feeding sites in Darwin Harbour so they can move between sites if the optimal habitat is disturbed or unavailable due to tidal conditions (Lilleyman & Garnett, 2019).

Details on the species-specific utilisation of habitats are described in Section 3.1 to 3.3. For the 26 species of shorebird that occur along the coastlines of Darwin Harbour, the habitats can be broadly categorised into four types (Lilleyman *et al*., 2019). These are:

1. **Intertidal sand and mudflats** used for foraging between high tides. The macro-tidal nature of tides in the Darwin region creates extensive mud and sand flats, available for foraging birds. This area is known as the intertidal zone and shorebirds often feed in this zone on what is considered a 'mudflat' (Lilleyman & Garnett, 2019). Feeding grounds appear to be widely available with extensive intertidal areas within the region, although the quality of these mudflats is yet to be tested (Lilleyman *et al*., 2018).

2. **Mangroves** used by some species for foraging and roosting at high tide.

3. **Saltpans** used for roosting at high tide. On tides less than 7.4 m, most saltpans (or claypans) are available to shorebirds to roost in, but not during tides above this height as these saltpans become inundated.

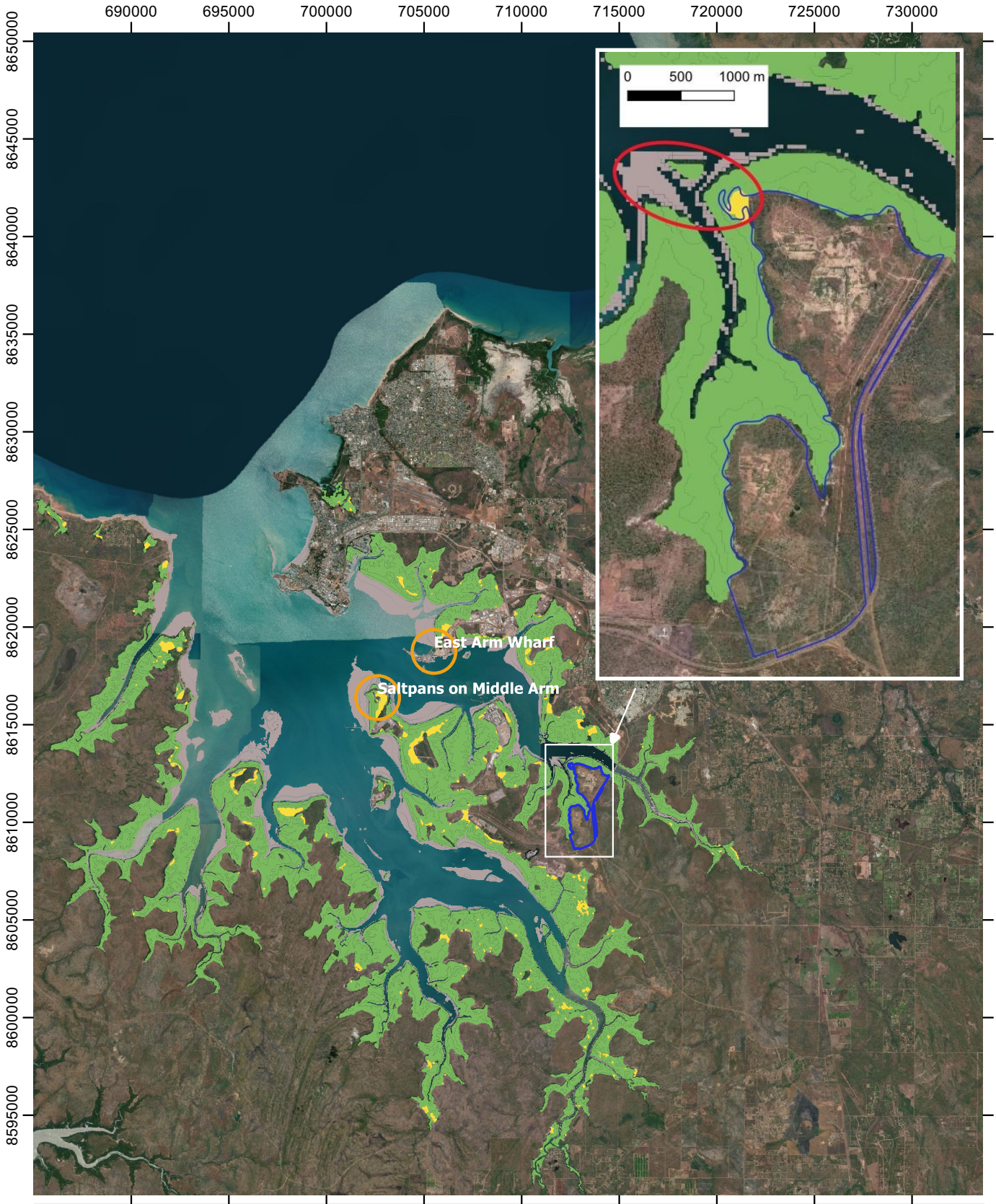
4. **Spring high tide roosting sites** used when the saltpans are inundated. The spring tide occurs twice per lunar month when the high and low tides are at their cyclical highest and lowest. Based on a whole-of-harbour aerial survey, the East Arm Wharf high tide roost site supports more than 30% of the total Darwin Harbour waterbird population (Lilleyman *et al*., 2018). The saltpans on the Middle Arm land peninsula (near Conoco Phillips project site) were used by shorebirds roosting during the 2017 surveys from Lilleyman *et al*. (2018) and considered the next most important spring high tide roosting area after the East Arm Wharf roost site based on numbers of shorebirds counted at the site during the 2017 aerial survey. In Darwin Harbour, shorebird numbers may be constrained by the availability of roosting sites, particularly high spring tide roosting sites.

The distributions of these habitat types in the Darwin Harbour are shown in **Figure 3-22**.

The distribution of Mangroves and Saltpans was obtained from the NT Mangroves 100k spatial polygon dataset (NTG, 2019). The distribution of intertidal mudflats was obtained from the National Intertidal Digital Elevation Model (**NIDEM**; Bishop-Taylor *et al*., 2019). The NIDEM provides a three-dimensional representation of Australia's intertidal sandy beaches and shores, tidal flats, and rocky shores and reefs at 25 m spatial resolution.

The location of spring high tide roosting sites was taken from Lilleyman *et al*. (2019).

The work of Lilleyman *et al*. (2019, 2020) draws attention to the importance of roost sites near to foraging ground, whether these are saltpan/saltmarsh roost sites or artificial habitat such as at East Arm Wharf, shorebirds appear to prefer to forage in areas close to roosting sites and roost in appropriate sites close to foraging grounds. Whilst foraging grounds and roosting habitats are well distributed around the harbour, it is the foraging and roosting sites in close proximity to each other that are of highest quality to shorebirds. One of these areas is present within proximity of the Project and is shown in **Figure 3-22**.



Legend

- Mangrove
- Saltpan
- Intertidal sand and mudflat
- Spring Tide Roosting Habitat
- High qaulity habitat near Project (inset)

Figure 3-22. Migratory shorebird habitats types in the Darwin Harbour

0 2.5 5 km

date: 22/01/2021
CRS: GDA94 MGA Zone 52
basemap: ESRI

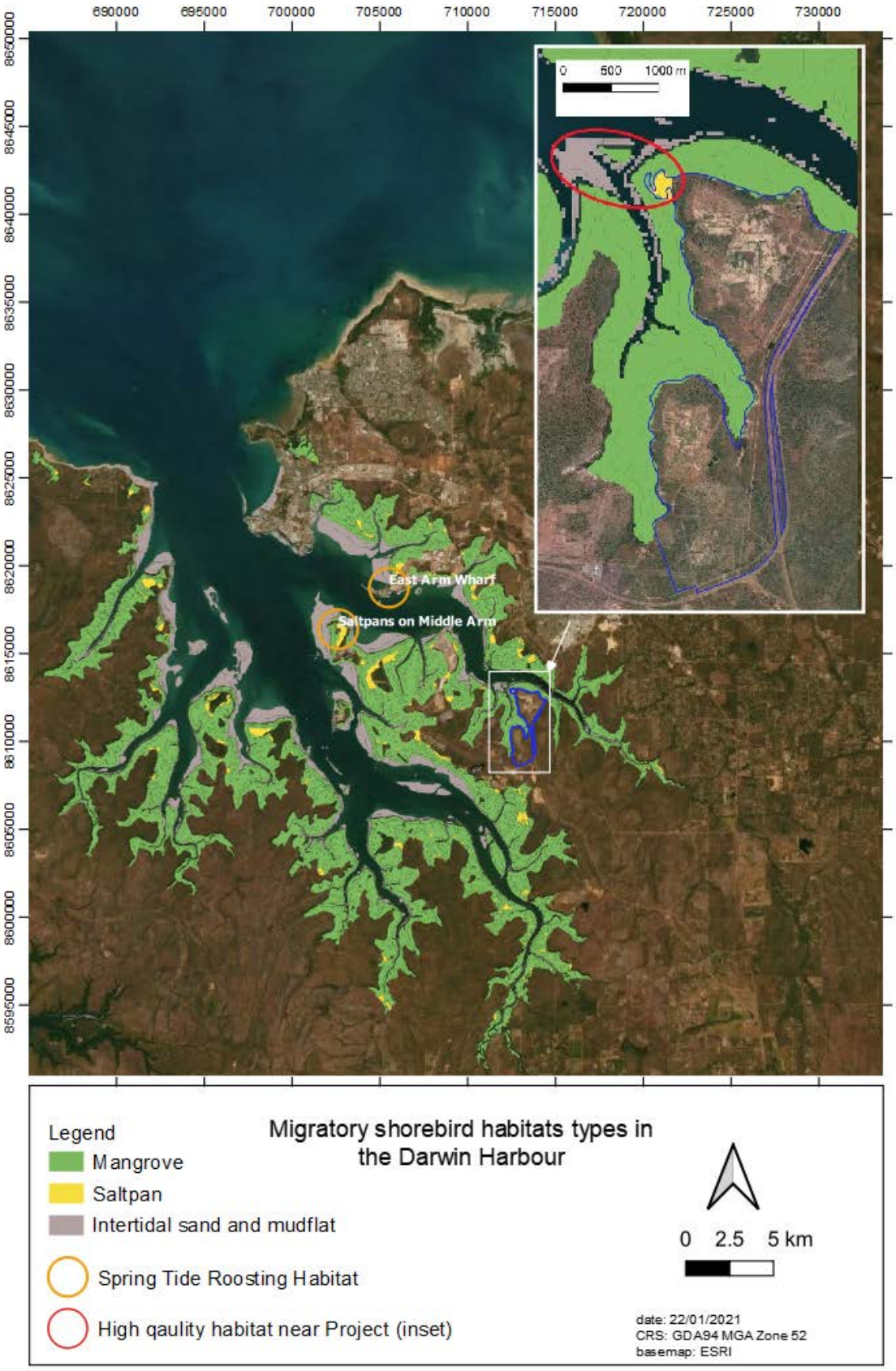


Figure 3-22. Migratory shorebird habitats types in the Darwin Harbour

3.5.3.4 Habitat Condition

The condition of the available habitats in the Darwin Harbour is near pristine (Munksgaard *et al*., 2018). Darwin Harbour is situated within a region recognised for its relative pristine condition (Halpern *et al*., 2008). Mangroves fringe the whole embayment of Darwin Harbour and comprise one of the largest (~20400 ha) and most floristically diverse (~41 species) areas of mangroves in the NT (Duke, 2006). Mangrove communities within the Harbour have been identified and mapped by Brocklehurst and Edmeades (1996) who concluded that overall the communities appear healthy and branch and tree death are generally due to natural processes.

Yet there are a number of pressures from the domestic and commercial development of Darwin plus the agricultural, horticultural and industrial activities within the Catchment that report to the Harbour, and the global pressures of climate change and rising oceans.

The north-eastern part of Darwin Harbour catchment is highly developed and native vegetation and tidal flats have been cleared and drained. With the current rapid growth of the city of Darwin, further pressure is likely to come from future recreational, residential and industrial developments within the Harbour (Wightman 2006). Major industrial developments around Middle Arm are currently being considered in line with its zoning for industrial development. Most of the mangrove clearing is happening in the higher tidal flat regions and the associated upper elevation mangrove species (Brocklehurst & Edmeades, 1996).

Nutrient enrichment from sewerage discharge and storm water run-off may affect mangrove communities in the Harbour (Dames & Moore, 1984 in Wightman, 2006). Despite having a macrotidal range of 7.8 m, the waters of Darwin Harbour are not particularly well flushed and recent research and modelling indicates that pollution may circulate within the upper reaches of the Harbour for considerable periods (Williams, 2006). Pollution and increased turbidity (e.g. from dredging) associated with future developments within the Harbour, may therefore affect water quality and the biodiversity values.

The Elizabeth River estuary is a major tributary of Darwin Harbour and the area surrounding the estuary is subject to increasing urban and industrial development (O2M, 2019). Due to urban developed in the Darwin wide metropolitan area there has been an increase in nutrients and sediments entering Darwin's Harbour waterways above natural levels and double the volume of stormwater runoff in wet season compared to an undisturbed landscape (Skinner *et al*., 2009). Increased nutrient loads in waterways can promote the growth of phytoplankton (microscopic plants) which can produce algal blooms and be toxic to marine life. In areas of higher nutrient levels, sediment can store the nutrients changing the composition of sediment fauna and flora. Additionally, higher nutrient concentrations may also promote excessive growth of macroalgae and epiphytes which can smother seagrass and coral. Mangroves are important in trapping and recycling nutrients, slowing or stopping their entry into the waterway (O2M, 2019).

The potential rise in sea level predicted in response to global climate change may affect mangrove communities in Darwin Harbour, especially in areas where coastal developments exclude the landward retreat of coastal ecosystems. Increased frequency of cyclone activity may impact mangroves as although mangroves are generally well adapted to the dynamic conditions at the land-sea interface, recovery from severe disturbance (e.g. storms, cyclones, clear-felling) may be very slow (Metcalfe, 2007). Indeed, severely damaged mangroves may take several decades to recover and such delayed recovery times increase their vulnerability to disturbance (McGuinness, 1992). It would be expected that landward migration under higher sea levels would also be a slow process, perhaps slower than the increase in sea level.

One immediate response to higher sea levels could be the re-colonisation of the saltpans by *Ceriops* as hypersaline conditions are ameliorated by more frequent tidal inundation (Brocklehurst & Edmeades, 1996). As the shorebirds use these saltpans every high tide cycle for roosting and as roosting availability is thought to be a limiting factor in the harbour shorebird population, this process could be detrimental to the sustainability of the population of shorebirds. A reduction in suitable roosting sites may lead to increased competition for

resources (Goss-Custard *et al*., 2002) or, in extreme circumstances, a population crash if suitable habitats are not available (Burton *et al*., 2006).

Whilst in Darwin Harbour, shorebird numbers may be constrained by the availability of roosting sites, feeding grounds appear to be widely available with extensive intertidal areas, although the quality of these mudflats is yet to be tested (Lilleyman *et al*., 2018). The biomass of invertebrate prey for shorebirds in the intertidal zone of Darwin Harbour is unknown. Most invertebrate survey work in the region has been performed in areas marked for development and in subtidal areas. This is a knowledge gap and no estimates on biomass availability can be made without the appropriate measurements and records of intertidal invertebrates (Lilleyman & Garnett, 2019). Therefore, although it is predicted that roosting site availability is the constraining factor in the Darwin Harbour shorebird populations, it is unknown how many shorebirds the harbour is able to support for feeding requirements.

Despite the pressures of the catchment reporting to the Harbour, the marine water quality in Darwin Harbour and Elizabeth River (up to Elizabeth River Bridge) is regarded as good to excellent, especially in comparison to waterways surrounding other major Australian cities. Darwin Harbour is one of the least-disturbed working harbours around the Australian coastline (DLRM, 2014). There is no evidence of widespread water or sediment pollution in the Harbour, although there is some localised pollution around the industrial estates (DLRM, 2014).

A detailed sampling study in the Middle Arm near the Elizabeth River Bridge performed by O2M (2019) found overall the marine and estuarine waters of Darwin Harbour and the Project area are considered to be in good to excellent quality with limited evidence of anthropogenic impacts. Overall, sediment quality in Darwin Harbour and in the vicinity of the Project area is of good quality with limited evidence of anthropogenic impacts.

3.5.4 Saltpan within Lot 1817

The saltpan within Lot 1817 is significant as it is known roosting habitat for the Eastern Curlew, which has been recorded there twice in surveys initiated by TNG and once by Lilleyman *et al* (2018). The number of Eastern Curlew recorded in the saltpan at any single survey is one or two.

4 SOURCES OF POTENTIAL IMPACTS

A number of potential impacts may arise from the construction and operation of the Project. The Project Terms of Reference listed a number of impacts that need to be considered. Some have been grouped together here as the pathways and receptors are similar; for example, if they present a similar risk to the habitat quality available to fauna in the vicinity of the Project. These are:

- vegetation clearance
- habitat fragmentation
- inappropriate or ineffective rehabilitation
- altered hydrology, and impacts on surface water and groundwater systems
- uncontrolled contaminated discharges, water quality impacts, and groundwater contamination
- acid sulphate soils
- erosion and sedimentation
- weed and pest invasion and spread
- human disturbance and vehicle strike
- lighting

- dust; and
- noise.

The Draft Environmental Impact Statement (**EIS**) risk identification and assessment process identified the following further risks associated with the project:

- bioaccumulation of toxic substances up the food chain
- uncontrolled fire; and
- fauna entrapment in infrastructure.

Stakeholder engagement through the Draft EIS process has identified a further potential impact related to a change in the proposed Processing methods, relating to:

- risk associated with the water quality of the Ponds used to reclaim process water.

The potential for each of these sources to impact significant fauna as a result of the project are discussed in the sections below. Impact sources can be temporary or permanent and result in changes to fauna or fauna habitat that are localised or reach beyond the Development Envelope.

4.1 VEGETATION CLEARANCE

Habitat loss is the single most important factor in the continuing decline of nearly all species of conservation significance (Cogger *et al.*, 1993; Garnett *et al.*, 2011; Woinarski *et al.*, 2014).

Vegetation clearing will result in habitat loss for some significant species. Clearing for the Project is confined to the Development Envelope which is 270.5 ha.

Significant habitat as defined in the NT Land Clearing Guidelines occurs within the Development Envelope. This is the 3.7 ha of land that contains the threshold density of trees ≥ 50 cm DBH. No other sensitive and significant vegetation as defined by the NT Land Clearing Guidelines occurs within the Development Envelope.

4.2 HABITAT FRAGMENTATION

Remnant terrestrial habitats within Lot 1817 are currently fragmented by the degraded land and fragmented from the more continuous habitats on Middle Arm by the Channel Island Road and the Adelaide-Darwin Railway line.

The Project may increase this fragmentation by reducing the remnant habitats through land clearing and increasing the traffic on the road and rail network.

No fragmentation of shorebird or marine habitats is expected to occur as a result of the Project.

4.3 HUMAN DISTURBANCE AND VEHICLE STRIKE

The existing level of human disturbance and vehicle strike at Lot 1817 is high. The site is currently heavily used for unregulated recreational purposes by people with dogs, motorbikes and cars. To the north of the Lot in the marine habitat is the Elizabeth River Boat Ramp which facilitates high recreational boat activity near the site such as crabbing or fishing, occurring on the intertidal zone adjacent to the site.

Human disturbance is expected to decrease at Lot 1817 as a result of the Project due to the reduced access to remnant habitats through Lot 1817.

The risk of vehicle strike to terrestrial significant fauna is also currently present. The Channel Island Road and Adelaide-Darwin Railway line present a risk to significant fauna wanting to move between habitat areas on middle arm and a number of mortalities have been recorded on the NT Fauna Atlas.

The Project risk of human disturbance and vehicle strike within Lot 1817 are highest during construction and significantly reduced during operation. During construction vehicle movements will be required to perform vegetation clearing and rehabilitation activities. There is a risk to fauna of vehicle strike during these activities.

Risk of vehicle strike on wildlife during operational phase is most likely to occur outside of Lot 1817 on the road and rail network supporting the operation at Lot 1817. The increase in traffic is expected to be 10 trips per week on the rail network and an additional 636 trips per day on the local road network during operation respectively. This is equivalent to 14% of the peak traffic usage recorded on the Channel Island Road in 2014. Traffic movement times are expected to occur at 7 am, 8 am, 4 pm, 6 pm and 7 pm. Sunset and sunrise times in Darwin are relatively consistent and the 7 pm traffic movement time (20 % of the Operations traffic) is the only time likely to be outside of daylight hours. This substantially decreases the likelihood of vehicle strike.

4.4 INTRODUCED SPECIES

Introduced species pose a range of potential impact sources to significant fauna. Potential impacts from introduced species include competition for prey, habitat degradation from weeds, poisoning from cane toads (Prugh *et al*., 2009), disease (e.g. toxoplasmosis (Dickman, 1996)), and the introduction of feral predators such as cats (Burbidge & McKenzie, 1989). Management of invasive species using poison (e.g. 1080 poison) is identified as a threat for some mammal species (Woinarski *et al*., 2014). Northern Quolls are identified as possibly being more susceptible to the toxin than other dasyurids (Calver *et al*., 1989).

4.4.1 Introduc*ed Fauna*

Six introduced fauna species have been recorded at Lot 1817. The most frequently recorded was the Cane Toad (*Rhinella marina*), which is found across all habitat types within the Project area. The Black Rat (*Rattus rattus*), Feral Cat (*Felis catus)*, Dog/Dingo (*Canis familiaris*), Feral Pig (*Sus scrofa*), and Asian House Gecko (*Hemidactylus frenatus*) were also recorded. Threat abatement plans (TAPs) are available for the Cane Toad (DSEWPAC, 2011), Feral Pig (DoEE, 2017), European Red Fox (DEWHA, 2008), and Feral Cat (DoE, 2015).

The domestic dog (*Canis familiaris*), is often present on the site as the current land use at Lot 1817 allows the unrestricted access of people and the location is frequently used as an off-leash dog exercising area.

In the NT, Foxes are found in the arid areas of Central Australia and the Barkly regions. They appear to be moving towards the Top End and are now common as far north as Tennant Creek (NTG, 2020).

The TAPs find that eradication of these introduced fauna species is not possible, and that identifying and prioritising the native species and ecological communities under threat and targeting action to protect those assets which have been determined to be of the highest priority, is the best use of resources.

Priority native species and ecological communities have been determined through peer-reviewed research to be highly vulnerable at population level to negative impacts from the presence of Cane Toads. Fauna determined to be vulnerable to Cane Toads are Northern Quoll (High (Oakwood, 2003a, b; O'Donnell 2009)), and Pale Field Rat (Moderate (Watson & Woinarski, 2003a, b)). In addition Cane Toads are recognised as a threatening process for Mertens Water Monitor and the Yellow-spotted Monitor.

The former extractive industries changed the site hydrology such that rainfall is no longer infiltrated into the shallow lateritic aquifer in the previously disturbed areas and instead is available as shallow open water during the wet season. These areas are suitable cane toad breeding environments.

Introduced predators such as cats and dogs are known to prefer open tracks and roads for rapid and low effort movement to hunting areas. There are currently a large number of tracks and roads present in Lot 1817 that

provide a network for introduced predators. Native species need to cross open track areas to move between the currently fragmented remnant woodland and forest areas.

Although feral animals are already established in the area, there is the potential for a range of invasive species to be attracted to the area as a result of operational activities such as waste and water management, and human habitation. Feral predators are considered likely to occur in greater numbers near areas of human settlement and roads/tracks (Andrews, 1990; Brown *et al*., 2006; Mahon *et al*., 1998). Introduced fauna are often attracted by food waste which they may hope to scavenge, or that may attract other smaller fauna prey such as mice and rats. Due to the location close to Darwin, an on-site landfill will not be required.

The Project is expected to reduce the occurrence of tracks and disturbed areas in the terrestrial habitats outside of the Development Envelope, and the existing Cane Toad breeding habitat will be reduced by 95% due to the allocation of the Development Envelope. Restricted access to the public will reduce the occurrence of dogs at the Site. Due to the currently frequent occurrence of introduced fauna and the expected changes in land use, the presence of the Project is expected to reduce the frequency of introduced fauna at the Site.

4.4.2 Introduced flora

Weed invasion by introduced plant species is common on disturbed land and inappropriate or ineffective rehabilitation often leads to weed invasion and spread, such as is already widespread at Lot 1817 as a result of the historic use by extractive industries. Field survey determined that weed density is high in the previously disturbed areas and low in the undisturbed vegetation with Gamba grass (**Andropogon gayanus*), a Class B weed in the Greater Darwin Region, reaching densities of over 60% cover. The Class B weed Mission grass (**Cenchrus polystachios*) was recorded in small patches and in clumped distributions on roadsides. Growth and spread of Class B weeds is required to be controlled under the NT *Weeds Management Act*.

Whilst introduced flora are already established in Lot 1817, the Project has the ability to cause further introduction and spread of weeds. Machinery and equipment used on site has the potential to increase the available habitat for weeds and spread weed seed. Gamba grass and Perennial mission grass are key weeds of concern as these grassy weeds are easily introduced and once present proliferate in disturbed areas. Without management, weed infestations could be expected to persist, and possibly proliferate into undisturbed areas of remnant vegetation.

Without effective management, the increased bushfire risk associated with grassy weeds could further degrade habitat quality in the area surrounding the project area, which is significant habitat for a number of significant fauna.

4.5 NOISE AND LIGHT

There is little research available on the impacts of noise and light to fauna locally, nationally or internationally.

Species using audible cues for breeding activity, especially birds and amphibians, may experience disruption to breeding cycles or reduced breeding success due to increased noise. For example, traffic noise is thought to negatively impact on bird and amphibian communities by masking territorial or mate attracting calls (Parris & Schneider, 2009; Shannon *et al*., 2014). Other behavioural responses to increased noise levels are reduced foraging time, through minimisation to exposure and by increased vigilance behaviour (Shannon *et al*., 2014).

There is no research currently available for the impact of noise on fauna specific to the Darwin Harbour Region, yet there are a few examples of commercial and industrial projects being constructed and operated in the Darwin Region within close proximity of terrestrial fauna habitats.

The Lee Point Defence Housing Development confirmed Black-footed Tree-rat habitat immediately adjacent to the development area. In the draft EIS for the project it was estimated that maximum noise during construction

of 116 to 133 db(A) for the activities clearing of vegetation and site establishment, bulk earthworks, installation of drainage infrastructure and road surfacing works.

The Ichthys Gas Field Development (INPEX) is on the Middle Arm Peninsula with similar quality terrestrial fauna and shorebird habitats available in the area surrounding the site. SVT completed a noise study prior to construction (SVT 2011) and predicted that the operational noise level would be 55 to 60 db(A) with peaks of 70 db(A) during construction.

Noise associated with the Darwin Wharf Precinct by SVT (2004) found noise to peak at 75dB(A) at 3m measured for motor noise from commercial fishing vessels. The DENR fauna database (DENR 2019) has many records of threatened and migratory avifauna within this precinct.

The East Arm Wharf is a Nationally Significant Aggregation of Waterbirds for three migratory shorebird species (Lesser Sand Plover, Greater Sand Plover, and Far Eastern Curlew) and on the basis of migratory shorebird species richness (Garnett 2012). Noise modelling by URS (2011) predicted the peak noise at Pond D to be between 65 and 70 db(A) during construction and between 55 and 60 db(A) during operation.

The Project noise modelling conducted for the Draft EIS and EIS Supplement has indicated that during construction, noise in the remnant terrestrial habitat would peak at between 50 to 60 db(A). During operation, noise in the terrestrial fauna habitats in the southern node is expected to be 40-50 db(A) and in the northern node 25 to 40 db(A). Noise in the saltpan/samphire roosting habitat closest to the Project would peak at between 40 to 47 db(A) and noise at the closest foraging site would peak at 40 db(A). Noise in the Mangrove habitat would be between 45 and 60 db(A) with the lower values towards the northward margin. During operation, noise in the saltpan/samphire roosting habitat and the foraging site would peak at 30 db(A). The Mangrove habitat would be between 50 and 30 db(A) with the lower values towards the northward margin.

The peak noise associated with the Project is expected to be associated with the train movements. It is estimated that peak noise of 120 db(A) at 10 m is likely to be generated from train movements. Train movements associated with the Project are anticipated to be 10 per week. Black-footed Tree-Rat currently inhabit the Eucalypt Woodland close to the existing train line where these peak noise levels are pre-existing.

The information presented above does not provide specific evidence of a lack of impact to fauna originating from industrial activity but places the Project within the range of previous noise-based disturbances within the locality and region in recent history. As none of the prior projects have considered the impact of the noise on fauna demographics or behaviour, it is not possible to predict what will be the impact of the noise associated with the Project. The risk is a reduction in habitat quality which may affect the suitability and reduce access to habitats that are currently used. Nearby industrial activity shows that the Black-footed Tree-rat and the Eastern Curlew are currently persisting in areas where similar or greater noise disturbance is occurring.

There has been limited research conducted on the impact of artificial light on shorebird species. In general, altered light environments may affect terrestrial fauna behaviours such as foraging, reproduction, migration, and communication (Longcore & Rich, 2004). Artificial lights are known to disorientate birds, particularly during migration, disrupt foraging behaviour, and reduce fledging success (CoA, 2020). A study by Rogers *et al*. (2006) suggested that shorebirds in northwest Australia may preferentially select roosting habitat with lower artificial light exposure, and consequently lower perceived predation risk. However, these sites were found to have greater energetic costs than sites with greater light exposure, as they were further from foraging sites. This may lead to starvation or failed migration.

Alternatively, artificial light may provide benefits to shorebirds, such as greater visibility of prey species, allowing for more efficient night-time foraging (CoA, 2020). A study in Scotland found altered foraging behaviours in *Tringa totanus* (Common Redshank), with the authors arguing that artificial light improved night-time visibility for the birds and, in turn, increased their foraging opportunities (Dwyer *et al*., 2012). Similarly, a study by Santos *et al*. (2010) found visual foragers (and, to a lesser extent, mixed foragers, but not tactile foragers) increased

their foraging effort in artificially lit sites. However, the authors cautioned that the artificial lighting may be drawing birds to lower quality habitat, which is more exposed to both human interactions and predators.

The Project is proposed to operate 24 hours per day 7 days per week. Lighting will be required at the facility to accommodate construction and operation on that schedule.

The Federal Government has published National Light Pollution Guidelines for Wildlife (CoA 2020). Best practice lighting design incorporates design principles that minimises exposure to artificial light.

Remnant and rehabilitated vegetation has been allocated to surround the Development Envelope and has the capacity to provide a substantial buffer of noise and light from the Project into significant fauna habitat areas. The band of vegetation ranging from 80 to 250 m plus the band of mangroves approximately 200 m wide offers significant buffering capacity for noise and light.

4.6 INAPPROPRIATE OR INEFFECTIVE REHABILITATION

TNG proposes to rehabilitate areas outside of the Development Envelope in Lot 1817 that are in Degraded or Completely Degraded condition. This consists of 64 ha of land that is previously disturbed recently rehabilitated or previously disturbed and not rehabilitated. TNG have prepared a Rehabilitation Management Plan to direct this work.

The recently rehabilitated land is dominated by a low number of *Acacia* shrub species and was assessed as in Degraded condition. The previously disturbed not rehabilitated land is dominated by Gamba Grass and was assessed as in Completely Degraded condition. These areas are representative of ineffective and inappropriate rehabilitation following use of the Lot by the former sand mining industry.

Weed invasion is common on disturbed land and inappropriate or ineffective rehabilitation often leads to weed invasion and spread. Gamba Grass (**Andropogon gayanus*) is a particular risk as it is common through the disturbed areas of Lot 1817. Weedy grasses can increase the fire risk and lead to inappropriate fire regimes. Weeds are discussed further in Introduced species and fire is discussed in Lightning and uncontrolled fire.

The rehabilitation areas have the potential to provide a number of ecological services. One service is to connect the remnant habitats that are currently fragmented by degraded areas. This would require the rehabilitation areas to provide sufficient habitat quality for targeted species. Another service is to provide a buffer for remnant habitats from light and noise originating from the Project. A third service is to improve the hydrological functioning of the Lot by increasing infiltration and filtering of surface water flows.

Inappropriate or ineffective rehabilitation risks the loss of opportunity to provide these services. As Inappropriate or ineffective rehabilitation predominantly leads to grassy weeds, there is also an increased fire risk.

4.7 ALTERED HYDROLOGY AND IMPACTS ON SURFACE WATER AND GROUNDWATER SYSTEMS

Hydrological processes refer to the occurrence, distribution, connectivity, movement and quantity of surface water and groundwater. Alteration of hydrology and surface and groundwater systems has the potential to impact fauna habitat characteristics.

The groundwater that occurs beneath the Site has been investigated through installation of monitoring bores and development of a hydrogeological model for the project area (Golder, 2019). A conceptual hydrogeological site model is presented for the wet and dry seasons in Section 7-5 of the Draft EIS.

The model shows that the hydrogeological cycle consists of rainfall recharge to the upper lateritic aquifer during the wet season, which creates a groundwater mound below the northern and southern peninsulas with radial

groundwater flow toward Elizabeth River and the intertidal tributaries. The hydrogeological conceptual model shows that rainfall is not infiltrating down to the Aquifer (**BCF**).

Significant alteration to the site hydrology has already occurred at Lot 1817 due to the former use by extractive industries. Large areas of Lot 1817 have had the thin lateritic aquifer removed substantially or entirely, leaving the BCF exposed. This causes rainwater to be diverted from the natural infiltration to the groundwater mounds to instead cause ponding of shallow water over much of the site in the wet season, which is then evaporated to the atmosphere rather than reporting to the Elizabeth River and the intertidal tributaries as it would if it were undisturbed.

Changes to hydrology may result from development as the Project will require vegetation clearing within the Development Envelope and the installation of impervious or sealed surfaces (e.g. buildings, roads). The groundwater beneath the site is believed to be predominantly recharged by infiltration of rainfall and as such, construction of sealed areas within the Development Envelope could limit recharge into the underlying aquifers. However, the Development Envelope has been allocated preferentially to disturbed areas where current disturbance has already altered hydrological processes and the impact is expected to be minor. Uncovered surfaces within the Development Envelope have a nominal cover of grass, gravel or mulch, which will allow infiltration of rainwater.

Surface hydrology at the site was documented by Golder (2019) for the Draft EIS. Peak flow of Stormwater in a minor and major rainfall event has been modelled for the EIS Supplement. The surface hydrology of the Project site will necessarily be altered by the addition of infrastructure. It is expected that there will be minor increases in runoff volume due to the establishment of impervious surfaces when the site is developed. Given the proposed location of the facility on the highest altitude positions of the two peninsulas that make up the site, only minor localised changes in runoff are predicted to occur as a result of the proposed facility as the areas receive minor runoff from adjacent locations. Stormwater within the Development Envelope will be collected, treated for contamination and discharged at dispersed locations. This will preserve the natural flow paths and any impact is expected to be minor.

The proposed access road and rail siding will require incorporation of appropriate cross-drainage features to accommodate external catchment runoff and prevent impacts on upslope drainage features associated with the Adelaide-Darwin Railway and Channel Islands Road. The Project Stormwater Management Plan identifies these locations.

It is expected that increased infiltration of rainwater to the shallow lateritic aquifer will occur in the rehabilitated areas where the restitution of surface soils and the increase in vegetation cover will promote infiltration and reduce runoff.

4.8 LIGHTNING AND UNCONTROLLED FIRE

Fire is a natural feature of the local environment which can occur as a result of lightning strikes. However, fire at Lot 1817 is currently more frequent and uncontrolled than is suitable for land so close to significant fauna habitat areas at a local and regional scale.

Fires at Lot 1817 are generally intentionally or unintentionally human lit because the area is frequently used for recreational activities. Evidence of multiple burned out cars and other human-lit fires are frequent at the site. Fire on Lot 1817 can quickly become uncontrolled late in the dry season due to the presence of weedy grass species such as Gamba grass and Annual Mission grass. Eradication of Gamba grass in Lot 1817 and the restriction of public access is likely to decrease the risk of fire at the site from its present high levels.

Establishment of industry can lead to an increased risk of fire through the introduction of ignition sources, such as grinding and welding, electrical arcing or shorting. Uncontrolled fire could cause mortality in individuals of significant fauna and decrease the quality of available habitat for significant fauna.

4.9 UNCONTROLLED CONTAMINATED DISCHARGES, ACID SULPHATE SOILS, WATER QUALITY IMPACTS, AND GROUNDWATER CONTAMINATION, BIOACCUMULATION OF TOXIC SUBSTANCES UP THE FOOD CHAIN

Uncontrolled contaminated discharges, acid sulphate soils, water quality impacts, and groundwater contamination and bioaccumulation of toxic substances up the food chain have been grouped as collectively they present the risk of decreasing habitat quality through pollution.

The baseline soil assessment identified the presence of actual and potential Acid Sulfate Soils (**ASS)** within certain areas of Lot 1817, however there is a high potential for ASS to be encountered more broadly across the Lot during the proposed construction works for the project. A detailed study of the distribution of ASS and PASS is scheduled to occur when the final disturbance footprint is determined but before any groundwork is commenced. Without management, the risk of ASS leading to contamination is very high.

There is potential that the chemical qualities of the surface and groundwater could be impacted by leaks or spills of chemicals, reagents, concentrates, hydrocarbons or cement residue during construction and processing activities. There is a high level of inherent risk (pre-mitigation) associated with alteration of the chemical characteristics of the surface water and shallow groundwater considering it is likely to discharge to the Elizabeth River, tributaries and ultimately, Darwin Harbour.

The aquifer/s that occur beneath the Site have been investigated through installation of monitoring bores and development of a hydrogeological model for the project area (Golder, 2019). Advisian (2021) conducted a seepage model to assess the likelihood of contaminated groundwater seeping from the Project into the Elizabeth River. The risk of contaminated groundwater seepage is low.

Advisian (2019) undertook a site flood assessment by developing a model. A storm surge at the Highest Astronomical Tide is likely to be low risk at the site due to the location of infrastructure outside the primary (1 in 100 Annual Exceedance Probability (**AEP**)) and secondary (1 in 1,000 AEP) storm surge inundation extents. The site is likely to be exposed to impact from a tertiary storm surge inundation (1 in 10,000 AEP) event. One of the recognised pathways a significant release of hazardous materials could occur is in the event of a 1 in 10,000 year flood event combined with a storm surge at maximum tide height. This may lead to flooding of key infrastructure and allow hazardous substances to be washed into the river via the upper lateritic aquifer. The likelihood however is rare (*i.e*. 1 in 10,000).

As discussed in Section 4.7 the Project will lead to an increase in stormwater flows due to the increase in impermeable surfaces. Stormwater can be a pathway for potential pollutants to contaminate surface water. The risk of stormwater leading to contamination of surface water that enters the Elizabeth River is high.

4.10 EROSION AND SEDIMENTATION

Erosion and sedimentation risks are expected to be highest during the construction phase of the Project. Clearing of vegetation, excavation and site levelling activities have the potential to facilitate migration of sediments into inland surface water bodies or site runoff. This is predominantly anticipated during the wet season. The Project has developed a Stormwater Management Plan to instruct this activity.

Potential impacts from increases in surface runoff are scour from runoff velocity, terrestrial erosion, smothering of aquatic flora and fauna and loss of aquatic habitat. The risk of stormwater leading to sedimentation of surface water that enters the Elizabeth River is high.

4.11 PONDS AND FAUNA ENTRAPMENT

Fauna, particularly waterbirds, are known to be attracted to artificial wetlands, particularly in the dry season when natural wetlands contract and dry out (DNRE 2019). The Palmerston Sewerage Treatment Ponds are a

nearby example of an artificial site that hosts a diversity and abundance of waterbirds (Experience the Wild 2020).

Impacts to wildlife resulting from interactions with water storage ponds can be avoided through engineering solutions. Decreasing the toxicity of the water supply is a key recommendation in the NTG (1998) '*Reducing impacts of tailings storage facilities on avian wildlife in the Northern Territory Best Practice Guidelines'*. Process liquid will be treated in a Water Recycling Plant (**WRP**) before being stored in tanks or, after meeting water quality targets, the Raw Water Pond. This water will pose no toxic threat to avifauna. Regular water quality monitoring will be conducted for the water leaving the WRP and entering and leaving the Raw Water Pond.

Barbed wire fencing poses a risk to bats. Bats can become snared by barbed wire fencing during feeding activities.

4.12 SUMMARY IMPACT SOURCES AND OUTCOMES

Table 4-1 summarises the relationship between impact sources and outcomes on fauna that may arise from the Project as detailed in Sections 4.1 to 4.11 above.

Table 4-1. Summary of the relationship between impact sources and outcomes on fauna that may arise from the Project

Impact source	Occurrence of impact within the Study Area	Impact pathways and potential impacts	Potential outcomes
Vegetation Clearance	• Total land disturbance of 270.5 ha	• Habitat loss • Response to disturbance or other behavioural changes in individual animals	• Mortality or displacement of individuals • Decline in population size • Local extinction • Reduction in the carrying capacity of the environment, or a reduction in the species or individuals that the environment can support • Reduction in diversity
Fragmentation	• Habitat loss within Lot 1817 • Increased local traffic	• Reduced access to suitable habitat	• Decline in population size • Reduction in the carrying capacity of the environment, or a reduction in the species or individuals that the environment can support • Reduced reproductive success • Reduction in diversity
Vehicle Strike	• Increase in traffic on Channel Island Road and Adelaide-Darwin Railway line. • Records of significant fauna being struck by vehicles on nearby roads (NT Fauna Atlas)	• Collision with animals	• Mortality or injury of individuals • Decline in population size
Introduced species	• Introduced fauna Cane Toad, Black Rat, Feral Cat, Dog/Dingo, Feral Pig, and Asian House Gecko have been recorded in the Study Area.	• Habitat degradation and loss (from weeds) • Competition for resources. • Predation • Increased mortality from toxic introduced species • Introduction/spread of disease.	• Mortality of individuals • Decline in population size

	• Introduced flora Gamba Grass and Annual Mission Grass have been recorded in the Study Area.	• Increased fuel loads from grassy weeds	
Increased noise	• Noise from the operation of heavy machinery and plant	• Responses to noise disturbance or other behavioural changes in individual animals • Species using audible cues for breeding activity may also experience disruption to breeding cycles or reduced breeding success. • Habitat modification or loss due to loss of habitat quality	• Displacement of individuals • Disruption to breeding • Reduced fitness
Increased light	• The Facility will run 24 hours a day so light will be required around buildings	• Responses to disturbance or other behavioural changes in individual animals, especially for light sensitive species • Changes in prey item aggregation for insectivorous species, resulting in changes to foraging behaviour	• Displacement of individuals • Decline in population size • Disruption to breeding
Inappropriate or ineffective rehabilitation	• Rehabilitation of 64 ha of land within Lot 1817 outside of the Development Envelope	• Increased weed invasion • Increased fire risk due to grassy weeds • Loss of opportunity to mitigate vegetation clearing	• Decline in population size
Altered hydrology	• Changes to groundwater recharge • Changes to surface water flow	• Habitat modification arising from local hydrogeological changes, including change in Mangrove composition or condition	• Changes in carrying capacity
Uncontrolled fire	• Currently frequent high intensity fires • Fire frequency and intensity expected to decrease	• Habitat modification; high frequency or intensity fires can reduce understorey habitat cover and reduce food sources and reduce the incidence of fire sensitive species or increase dominance of fire resilient species • Low frequency fires can result in dominance of senescent vegetation and high fuel loads.	• Mortality or injury of individuals • Decline in population size • Reduction in carrying capacity • Changes in species • Reduction in faunal diversity
Pollution	• Seepage from disturbance to ASS and PASS areas • Flooding • Seepage from storage areas	• Habitat modification – loss of pollution sensitive species • Loss of habitat quality	• Decline in carrying capacity • Changes in species • Reduction in faunal diversity

Erosion and sedimentation	• Ground disturbance during construction	• Habitat modification – loss of pollution sensitive species • Loss of habitat quality	• Reduction in carrying capacity • Changes in species • Reduction in faunal diversity
Ponds and Entrapment	• Fencing of the facility • Ponds	• Ensnarement in fencing • Attraction to open water	• Mortality or injury of individuals • Decline in population size

5 CRITERIA FOR ASSESSING IMPACTS

5.1 NORTHERN TERRITORY

The meaning of significant impact is defined in the Northern Territory *Environmental Protection Act (2019)* (**EP Act**) as:

A significant impact of an action is an impact of major consequence having regard to:

(a) the context and intensity of the impact; and

(b) the sensitivity, value and quality of the environment impacted on and the duration, magnitude and geographic extent of the impact.

This has been taken into account through the definitions of the categories used to assess risks associated with the Project. The risk assessment methodology is described in detail in the EIS Supplement Appendix X. **Table 5-1** summarises the criteria used for assessment of risk in Section 6.1.

Table 5-1. Impact criteria used to assess the extent for each potential impact source

Criteria	Assessment Value	Definition
Duration	Permanent	Impact that is permanent; environmental values will not recover on human time scales
	Long term	Impact that is measurable post-Project
	Medium term	Impact that is felt up to completion of operations
	Short-term	Impact that is felt up to completion of construction
Scale	Widespread	Impact occurs at a NT, national, international or global scale
	Regional	Impact extends to the Darwin/ Palmerston region, and/ or greater Darwin Harbour
	Localised	Impact is confined to the Site and areas directly adjacent to the Site, such as other allotments, Elizabeth River, and estuarine watercourses adjacent to the Site
	Limited	Impact limited to the Site
Intensity	High	Impact irreversibly compromises the integrity of environmental values
	Moderate	Integrity of environmental values altered but impact can practicably be reversed
	Low	Impact alters the quality, abundance or distribution of environmental values without compromising their integrity, and can be easily and cheaply reversed
	Very Low	Impact does not significantly alter the quality, distribution or abundance of environmental values.

5.2 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

For species considered MNES, significant impact criteria developed by DoE (2013) are also used to assess impacts. The criteria assessed for each species follows significant impact criteria for EN and VU species specified by DoE (2013) as well as the conservation listing advice for specific species where available.

For this Assessment the definition of a 'significant impact' follows that of the DAWE, being an impact, which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts (DoE, 2013). The DoE (2013) state that for an impact to be 'likely', it is not necessary for a significant impact to have a greater

than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility.

For this Assessment, species listed as MNES (DoE, 2013) that have been confirmed to occur, are Likely to Occur or may possibly occur within the Study Area have been assessed in accordance with DoE guidelines (DoE, 2013) to determine whether the Project will have a significant impact on their survival. Species that are Unlikely to occur have not been considered.

DoE (2013) defines an 'important population' as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

Habitat critical to the survival of a species refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

The Northern Quoll referral guidelines (DoE, 2016) define populations important for the long-term survival of the species as;

• high density quoll populations, which occur in refuge-rich habitat critical to the survival of the species, including where Cane Toads are present;

• occurring in habitat that is free of cane toads and unlikely to support cane toads upon arrival *i.e*. granite habitats in WA, populations surrounded by desert and without permanent water; or

• subject to ongoing conservation or research actions (*i.e*. populations being monitored by government agencies or universities or subject to reintroductions or translocation).

A high density population may be characterised by numerous camera triggers of multiple individuals across multiple cameras and or traps on the site (DoE, 2016).

6 IMPACT ASSESSMENT OF KEY RECEPTORS

6.1 IMPACTS TO FAUNA HABITATS

Land clearance is listed as a Key Threatening Process under the EPBC Act and is a key impact to the significant fauna as a result of the Project. The estimated quantity of each habitat that will be potentially impacted by the Project is current for the EIS Supplement and is presented in **Table 6-1**. Habitat loss and degradation will occur predominantly in previously disturbed land that is degraded or completely degraded, however some areas of suitable habitat for significant terrestrial fauna, particularly the Mixed Woodland, will be cleared (**Table 6-1**).

Table 6-1. Habitats to be cleared

Habitat	Habitat value	Clearing Area	Regional Extent	
		ha	ha	% loss
Mixed Woodland	High	92.5	7,543	1.22
Native grassland	Low	51.1	3122	1.26
Melaleuca woodland	Low	5.9	4770	0.12
Temporary Water Bodies	Low	11.7	NA	
Disturbed areas	Low	109.3	NA	
		270.5		

*Figures sourced from DENR (2020)
NA: Not available, previously disturbed no natural analogue

Figures used to calculate the regional extent of the vegetation type were sourced from the digitisation of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000) last updated on the 29/06/2016. The regional extent for Temporary Water Bodies is determined as NA as the bodies in Lot 1817 are created by the historic extractive industries and not equivalent to natural inundation areas in the Elizabeth, Darwin and Blackmore River Catchments.

Habitat loss or degradation will have the greatest impact in the Mixed Woodland. However, there is habitat connectivity outside of the Development Envelope within Lot 1817, and large areas of undisturbed high quality habitat to the east. None of the habitat types to be cleared are restricted to the Study Area and are well represented regionally. Rehabilitation of degraded areas outside of the Development Envelope within Lot 1817 will decrease the fragmentation of remnant areas.

The scale of the impact is limited to the site and the intensity is expected to be low due to the high availability of suitable habitat nearby. The impact will alter the quality, abundance or distribution of environmental values without compromising their integrity.

Potential indirect impacts on terrestrial fauna habitats may include changes to fire regimes, increases in the abundance of introduced species and lowering of habitat quality due to noise and light.

Potential indirect impacts on shorebird fauna habitats are changes to mangrove and saltpan habitats due to changes in hydrology, and lowering of habitat quality from pollution, noise and light.

6.2 POTENTIAL IMPACTS TO HABITAT FEATURES

The Project will require the clearing of 92.5 ha of Mixed Woodland habitat. TNG have prepared a Rehabilitation Management Plan for the 64 ha of degraded land available for immediate rehabilitation. This will produce in a residual loss of 28.5 ha of Mixed Woodland. The retained and rehabilitated Mixed woodland habitat may be impacted by the noise and light originating from the Project, however the expected noise and light are within the limits previously accepted in the Darwin Harbour and significant fauna have been recorded to be persisting in areas of similar noise level in the area (Section 4.5).

Within the Mixed Woodland nominated for clearing is the 3.7 ha of significant habitat containing the threshold number of trees ≥ 50 cm DBH. This will reduce the availability of nesting or roosting sites for species that require tree hollows.

The Mixed Woodland habitat may receive a net benefit from the Project due to the rehabilitation of degraded land. This will occur as a result of the removal of a number of present risks, and the improvement of ecosystem services. The high grassy weed load, the human disturbance (including frequent ignition sources) and the suitability of the land for introduced fauna will all be reduced as a result of the Project. The current nature of surface soils provides poor support for natural hydrological processes and burrowing potential, and the current vegetation provides poor habitat quality. The Rehabilitation Management Plan provides a strategy for improving these outcomes.

Some Melaleuca woodland vegetation will be cleared however this is not significant vegetation under the NT Land Clearing Guidelines as it is not riparian vegetation. It is previously disturbed land (likely Eucalypt Woodland prior to clearing) that has been altered to be seasonally inundated, and is now suitable for Melaleuca spp. It is in degraded condition.

Other sensitive and significant vegetation may be impacted indirectly. Hydrology is important in the distribution and abundance of mangrove vegetation in the Darwin Harbour, with mangrove species distributed based upon the specific mix of freshwater and brackish water and the depth of inundation (Brocklehurst and Edmeades 1996). Low quality water, either sediment laden or containing chemicals or low pH water from ASS would also affect the health of mangroves. The Stormwater Management Plan nominates the management of poor quality water and the locations at the site where water would be discharged in a high rainfall event. These areas are dispersed and located with reference to natural surface drainage features, maintaining the pre-development surface water regime and the risk of this occurring as a result of surface water is Low. Changes to the groundwater regime are unlikely to occur as the Development Envelope has been allocated to the previously disturbed land where hydrology has been altered. Any impacts will be limited and the risk is low.

The saltpan within 1817 may have mangroves encroach if the amount of freshwater flushing through it increases (Brocklehurst & Edmeades, 1996). The Stormwater management plan nominates the locations at the site where water would be discharged in a high rainfall event. These areas are following natural drainage lines and are located away from the saltpan and the risk of this occurring is Low.

The saltpan and mangrove habitats may also be impacted by noise and light originating from the Project. The noise during the construction phase is short term. The Project Layout has been allocated in a way that places the greatest operational noise and light sources as far away from these key habitat receptors as possible within Lot 1817. As recommended by CoA (2017) vegetation buffer has been allocated between the Development Envelope and these habitats, and as a consequence of the layout and the buffer, the risk of noise and light impacting these habitats during operations is Low. The persistence of shorebirds in similar proximity to other noise sources in the Darwin Harbour indicates the certainty is moderate to high.

The Internationally and nationally significant aggregations of shorebirds occur at Lee Point, East Arm Wharf and the Saltpans on Middle Arm. These locations are 26 km, 10 km and 11 km from the Project respectively. At this distance they will not be impacted by noise and light originating from the Project, as the impacts from noise and light are limited to the local scale. The risk from these sources is Low. No impacts arising from the Project are expected to pose any risk to the Nationally or Internationally Significant Aggregations of Waterbirds as the impacts described in Section 4 are not of a scale that will impact those sites.

DLRM (2014) and Alongi *et al*. (2016) identified threats to the future ecological health of Darwin Harbour. Two of these are excess sediment deposition from runoff and dredging and pollution by catchment-derived nutrients and toxicants (DLRM 2014; Alongi *et al*. 2016). Sedimentation is most likely to affect shorebirds indirectly, through disruption to benthic infauna. Shorebirds are likely to have adaptable foraging strategies that enable

them to persist through periods of localised sedimentation and invertebrate decline (see Rogers *et al*., 2006), however widespread or prolonged decline in food availability will cause eventual loss of habitat quality leading ultimately to habitat loss. A Stormwater Management Plan has been prepared for the Project that minimises the risk of sedimentation through the application of controls for stormwater in line with guidelines and regulations.

Low quality water originating from the site, either contaminated from chemicals or low pH water from ASS, are expected under worst case scenario to have a localised impact. The risk of these impacts from the Project to the sites of Internationally and nationally significant aggregations of shorebirds is Low. The risk to mangrove, saltpan and intertidal mudflat areas is also Low.

6.3 POTENTIAL IMPACTS ON FAUNA SPECIES

Overall, habitat removal is considered to be the primary impact to conservation significant fauna within the Study Area. Habitat loss or degradation is listed as a Threatening Process for the Red Knot, Red Knot, Curlew Sandpiper, Great Knot, Greater Sand plover, Lesser Sand Plover, Eastern Curlew, Bar-tailed Godwit, Fawn Antechinus, Northern Quoll, Black Footed Tree Rat, Pale Field Rat and the Bare-rumped Sheathtail Bat.

Potential increases to the abundance of introduced species due to the Project could impact some terrestrial conservation significant fauna in the Study Area via predation and competition for food resources. Vehicle strike may also have an impact on some terrestrial species.

Pollution is considered to be the primary risk to significant fauna dependant on shorebird and marine environments in close proximity to the Project, with poor water quality being via a range of means including sedimentation, ASS or contaminants from the Processing circuit.

Changes to the site hydrology risk changes to the health of the saltpan and mangrove habitats which may impact the availability of these habitats for significant avifauna.

Water pollution is considered highly likely to have a significant impact on shorebird species (CoA, 2017). Acid sulphate soils that change the chemical balance of an area are considered to have a significant impact on shorebirds (CoA, 2017). One of the four main threats to the future ecological health of Darwin Harbour has been identified as pollution by catchment-derived nutrients and toxicants (DLRM 2014; Alongi *et al*. 2016). For migratory shorebird species in the Elizabeth River and Darwin Harbour this may cause a reduction in the local food quality and availability. Prey species may be killed, reducing the quantity of available food. If toxic substances bioaccumulate in the benthic infauna prey there is a risk of poisoning for migratory shorebirds.

The Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) reports that disturbance from human activities has a high energetic cost to shorebirds and may compromise their capacity to build sufficient energy reserves to undertake migration (Goss-Custard *et al*. 2006; Weston *et al*. 2012). Disturbance which renders an area unusable is equivalent to habitat loss and can exacerbate population declines. Disturbance is greatest where increasing human populations and development pressures may have an impact on important habitats. Migratory shorebirds are most susceptible to disturbance during daytime roosting and foraging periods.

Section 6.3.1 discusses the impacts to significant fauna known to occur in the Study Area. Section 6.3.2 discusses the impacts to species considered likely to occur. **Table 6-2** (Section 6.3.3) summarises the potential impacts of the Project on a species by species basis for fauna of conservation significance that are confirmed to occur, likely to occur and includes species that have been determined to possibly occur in the Study Area. Other vertebrate fauna within the Study Area, including common and widespread species, would also be subject to a similar range of impacts.

It should be noted that the direct and indirect impact sources that may affect key receptor species can be difficult to quantify and predict in advance of developments occurring. Although land clearing or degradation may be estimated, the final impact to the local populations or regional distribution of a species is difficult to quantify. The extent and magnitude of other impact sources, such as noise, light, or changed fire regimes, have not been

well researched for fauna species of the Darwin Harbour, and the final impact assessment is limited in its accuracy. To allow for this an assessment is also provided of the level of certainty with which the assessment has been applied.

6.3.1 Potential Impacts on Species Occurring in the Study Area

6.3.1.1 Far Eastern Curlew

Within the Study Area high quality habitat is found in the Mangroves, Saltpan and intertidal mudflats. The impact considered to be of most significance for this species is habitat degradation as a result of changes to hydrological processes and pollution. The risk of changes to hydrological processes is medium. Without mitigation, the risk of pollution is high.

The risk of noise and light impacting these habitats within the Study Area is considered low due to the positioning of Project features and the vegetation buffer allocated between the Development Envelope and key habitats.

The risk of Project impacts reaching the nationally significant aggregation site of the East Arm Wharf is Low due to the distance between the Project and the East Arm Wharf, and the expected scale of impact sources to be limited or localised.

Overall the Project is not likely to have a significant impact on the species on a local, regional or international scale, as defined by the DAWE.

6.3.1.2 Curlew Sandpiper

Within the Study Area the species has been recorded in the intertidal mudflats, but the saltpan may also be suitable habitat. The impact considered to be of most significance for this species is habitat degradation as a result of pollution. Without mitigation, the risk of pollution is high.

The risk of noise and light impacting these habitats within the Study Area is considered low due to the positioning of Project features and the vegetation buffer allocated between the Development Envelope and key habitats.

The risk of Project impacts reaching the nationally significant aggregation site of Lee Point or the East Arm Wharf is Low due to the distance between the Project and these sites, and the expected scale of impact sources to be limited or localised.

Overall the Project is not likely to have a significant impact on the species on a local, regional or international scale, as defined by the DAWE.

6.3.1.3 Black-footed Tree-rat

Within the Study Area, high quality habitat is found within the Mixed Woodland. The species prefers to nest in tree hollows, and the 3.7 ha of significant habitat trees will be a loss of nesting habitat for this species. The low availability of large trees on the site indicated there is likely a high competition for tree hollows within the Study Area, and the Black-footed Tree-rat may already utilise the more readily available *Pandanus*.

At a local scale the species is likely to experience a Low to Medium level of impact, primarily from the removal of habitat but also potentially vehicle strike during vegetation clearing, the increased threat of introduced species and fire risk. Low level impacts may also be experienced by increased light and noise.

Continuous undisturbed habitat occurs to the east of Channel Island Road and the Adelaide-Darwin Railway line that supports the greater proportion of the Black-footed Tree-rat population on Middle Arm. Lot 1817 is already fragmented from this habitat by the road and rail network. Increased traffic as a result of the Project may increase the level of fragmentation, however traffic movements are predominantly scheduled to occur in the day when the species is sleeping so the increased risk from the Project is low.

As the majority of the Middle Arm population occurs east of the Channel Island Road and the Adelaide-Darwin Railway line and the proportion of habitat within the Study Area is small and already highly disturbed in comparison, the impacts to the species are not likely to be significant as defined by DAWE.

6.3.1.4 Pale Field Rat

One Pale Field Rat individual was recorded in the Monsoon Closed Forest habitat in the Study Area. This habitat is not within the Development Envelope and no habitat loss will occur.

The species may be at Low level risk from any increase in introduced species and increased fire risk.

The risk of vehicle strike or impacts from noise and light are Low as the Monsoon Closed Forest habitat is not near to these impact sources and a vegetation buffer has been allocated between the habitat and the Development Envelope.

Overall the Project is not likely to have a significant impact on the species on a local or regional scale, as defined by the DAWE.

6.3.1.5 Howard River Toadlet

The Howard River Toadlet was recorded from physical characteristics by GHD in 2017 in the Melaleuca woodlands however the species can only be definitively identified with the aid of calls and the species is known to be confined to sand sheet heath habitats. There are no sand sheet heath habitats present in the Study Area.

Based on these factors it is considered unlikely that Howard River Toadlet is present and the Project is very unlikely to have a significant impact upon the species. Due to this, the species is not considered in the sections below.

6.3.1.6 Migratory species

The Common Sandpiper, Common Greenshank, Whimbrel and Little Tern have all been recorded using the shorebird habitats within the Study Area.

No habitat loss is proposed for these species. The impact considered to be of most significance for these species is habitat degradation as a result of pollution. Without mitigation, the risk of pollution is high.

The risk of noise and light impacting these habitats within the Study Area is considered low due to the positioning of Project features and the vegetation buffer allocated between the Development Envelope and key migratory shorebird habitats.

The risk of Project impacts reaching the nationally significant aggregation sites of Middle Arm, East Arm Wharf or Eat Point to Lee Point is Low due to the distance between the Project and these sites, and the expected scale of impact sources to be limited or localised.

Overall the Project is not likely to have a significant impact on these species on a local, regional or international scale, as defined by the DAWE.

Fork Tailed Swift uses the aerial habitats over the Study Area for foraging. The species is rarely known to land. The Project has the potential to reduce the available foraging habitat, however this would be by less than 0.01% of the suitable available habitat in the Darwin Harbour and the Project will not cause a significant impact to the species locally or regionally.

The Oriental Cuckoo has been recorded once at the Study Area.

The Mixed Woodland is also suitable habitat for the Oriental Cuckoo and Eastern Osprey. Loss of a proportion of this habitat will occur as a result of the project. Some of this habitat will be retained and large areas of undisturbed high quality habitat occur nearby. Overall the Project is not likely to have a significant impact on these species on a local, regional or international scale, as defined by the DAWE.

The Saltwater Crocodile uses the mangrove habitats of the Study Area however this species is actively managed in the Darwin Harbour under the NT crocodile capture and removal program. As crocodiles are actively removed from the site the Project is very unlikely to have a significant impact on the species.

6.3.2 Potential Impacts on Species Likely to or Possibly Occurring in the Study Area

The Red Knot, Curlew Sandpiper, Great Knot, Lesser Sand Plover and Bar-tailed Godwit are likely to occur periodically in the shorebird habitats in the Study Area. The Sharp-tailed Sandpiper, Pectoral Sandpiper, Oriental Pranticole, Oriental Plover, Ruddy turnstone, Sanderling, Red-necked Stint, Long-toed Stint, Little Ringed Plover, Asian Dowitcher, Black-tailed Godwit, Little Curlew, Pacific Golden Plover, Grey Plover, Wood Sandpiper, Marsh Sandpiper and Terek Sandpiper possibly occur periodically in the shorebird habitats in the Study Area.

The risk of noise and light impacting these habitats within the Study Area is considered low due to the positioning of Project features and the vegetation buffer allocated between the Development Envelope and key migratory shorebird habitats.

The risk of Project impacts reaching the nationally significant aggregation sites of Middle Arm, East Arm Wharf or Eat Point to Lee Point is Low due to the distance between the Project and these sites, and the expected scale of impact sources to be limited or localised.

Overall the Project is not likely to have a significant impact on these species on a local, regional or international scale, as defined by the DAWE.

The Northern Quoll, Yellow Spotted Monitor and the Bare-rumped Sheathtail Bat are considered Likely to occur in Lot 1817 as suitable habitat is present and occurs within the Development Envelope. The impact to these species is loss of potentially suitable habitat that may have been available for use at some time in the future. No critical habitat for the Northern Quoll (CoA 2016) occurs in the Study Area.

The Mixed Woodland habitat type that comprises their preferred habitat is widespread in the Greater Darwin area, particularly in the area of Middle Arm where large and undisturbed areas occur both on Middle Arm and further inland to the east. Clearing of the potential habitat in Lot 1817 is not considered to constitute a loss of significant habitat and will not impact the sustainability of the populations of these species in the Greater Darwin area.

The Fawn Antechinus and Mertens' Water Monitor are considered as Possible to occur within Lot 1817 at some times. Clearing of the potential habitat in Lot 1817 is not considered to constitute a loss of significant habitat and will not impact the sustainability of the populations of these species in the Greater Darwin area.

Overall the Project is not likely to have a significant impact on these species on a local or regional scale, as defined by the DAWE.

6.3.3 Potential impacts to species – species by species assessment

Table 6-2 provides a species by species assessment of the potential impacts from the Project.

Table 6-2. Potential impacts to significant fauna from sources originating from the Project

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
Eastern Curlew *Numenius madagascariensis* EPBC Act: CR, Mi TPWC Act: VU	Confirmed	Habitat Loss	Limited. No vegetation clearing will occur in Eastern Curlew Habitat	Permanent	No impact	No impact	None	High. No habitat suitable for the Eastern Curlew occurs within the Development Envelope
		Habitat Fragmentation	Local. No habitats will be fragmented	Permanent	Negligible. The Project does not fragment any shorebird habitats, or decrease the connectivity of local habitats	Negligible. The Project does not fragment any shorebird habitats, or decrease the connectivity of regional habitats	None	High. The Project occurs on the margin of shorebird habitat and does not interrupt the connectivity of habitats within the Darwin Harbour.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term (2 years) Operation: Long term (40 years)	Low – Vehicles are not expected to occur in the shorebird habitat. During rehabilitation works in the construction period earthmoving vehicles may work in close proximity (within 50 m) of mangrove habitat but this is likely to be of very short duration (a few days). Most construction activity will be in excess of 200 m from shorebird habitat. Shorebirds are unlikely to be active near the Channel Island Road or Adelaide-Darwin Railway line as no suitable habitat is present. Human disturbance will decrease due to the restricted public access	Negligible – there is unlikely to be a significant impact to this species due to human disturbance or vehicle strike in the broader region.	Mortality or injury of individuals Decline in population size	High – the effects of human disturbance on migratory shorebirds is well established
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Moderate. Potential impacts of introduced species are spread of weedy grasses already present in the Study Area, leading to increased fire risk. Increased predators such as cats and dogs are a risk to Eastern Curlew.	Moderate. Introduced species likely to be attracted to the Project are already well established in the Region, however, increased fire risk as a result of weedy grasses is a significant risk in the region.	Mortality of individuals Decline in population size	Moderate – impacts by introduced species on migratory birds are well recorded.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Low. The Project has been allocated to the available land in a way that maximises the distance between the high noise and light sources and the Eastern Curlew habitats. The magnitude and scale of the impact is within the limits of previous projects where Eastern Curlew has persisted. A vegetation buffer has been allocated to reduce the impact.	Negligible. The scale and magnitude of the impacts will not have an impact to Eastern Curlew in the broader region.	Displacement of individuals Reduced fitness	Low. Impacts of noise and light have not been studied for this species and general data has inconsistent findings. Eastern Curlew persist in noisy areas but there is no specific knowledge of the physiological impact on fitness
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Moderate. Poorly rehabilitated land is prone to introduced species. These have risks of are spread of weedy grasses already present in the Study Area, leading to increased fire risk. Increased predators such as cats and dogs. Successful rehabilitation will provide improved hydrological function in currently disturbed areas that will benefit shorebird habitats.	Low. The impact would be contained to the Study Area.	Decline in population size	Moderate – impacts by introduced species on migratory birds are well recorded. Impacts of changes in hydrology to shorebird habitats are understood.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Saltpans and Mangroves are sensitive to changes in hydrological processes however the Project has been assessed as low risk of altering hydrological processes.	Low. Impacts would be at a local scale.	Change in carrying capacity	High. Impacts of changes in hydrology to saltpan and mangrove habitats are understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Moderate. High intensity fire would have a detrimental local impact on habitat quality and prey availability through the decrease in water quality associated with ash being transported into the waterway.	Moderate. Fires inadvertently started at the Study Area may potentially escape and burn beyond the boundary and subsequently impact on the suitability of habitat in the region or the scale of the	Mortality or injury of individuals Decline in population size	Medium. The extent to which the species habitat is impacted by fire is not well researched.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
						impact through ash load from the catchment.	Reduction in carrying capacity	
		Contamination of surface and groundwater	Local	Permanent	Medium. There is a medium risk of contamination of surface and groundwater as a result of the Project. This may reduce habitat quality for this species locally	Low. Impacts would be at a local scale.	Decline in carrying capacity	
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. The risk of erosion and sedimentation for the Project is Low	Low. Impacts would be at a local scale.	Decline in carrying capacity	High. A Stormwater Management Plan has been prepared for the Project including guideline and Policy recommendations from the Darwin Harbour Advisory Committee
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Eastern Curlew have been recorded at the Palmerston Sewerage Treatment Ponds and occur in nationally significant numbers at the East Arm Wharf indicating artificial habitats can be suitable. The water quality in the Ponds will not be harmful to Eastern Curlew and ponds will be designed to be poor quality habitat to shorebirds.	Negligible. Strategies to reduce risk and detract shorebirds from open water storages are well established and effective.	Mortality or injury of individuals Decline in population size	High. Eastern Curlew are known to inhabit artificial wetlands, but strategies to reduce risk and detract shorebirds from Ponds are well established.
Greater Sand Plover *Charadrius leschenaultii* EPBC Act: VU, Mi TPWC Act: VU	Confirmed	Habitat Loss	Limited. No vegetation clearing will occur in Greater Sand Plover Habitat	Permanent	No impact	No impact	None	High. No habitat suitable for the Greater Sand Plover occurs within the Development Envelope
		Habitat Fragmentation	Local. No habitats will be fragmented	Permanent	Negligible. The Project does not fragment any shorebird habitats, or decrease the connectivity of local habitats	Negligible. The Project does not fragment any shorebird habitats, or decrease the connectivity of regional habitats	None	High. The Project occurs on the margin of shorebird habitat and does not interrupt the connectivity of habitats within the Darwin Harbour.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term (2 years) Operation: Long term (40 years)	Low – Vehicles are not expected to occur in the shorebird habitat. During rehabilitation works in the construction period earthmoving vehicles may work in close proximity (within 50 m) of mangrove habitat but this is likely to be of very short duration (a few days). Most construction activity will be in excess of 200 m from shorebird habitat. Shorebirds are unlikely to be active near the Channel Island Road or Adelaide-Darwin Railway line as no suitable habitat is present. Human disturbance will decrease due to the restricted public access	Negligible – there is unlikely to be a significant impact to this species due to human disturbance or vehicle strike in the broader region.	Mortality or injury of individuals Decline in population size	High – the effects of human disturbance on migratory shorebirds is well established
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Moderate. Potential impacts of introduced species are spread of weedy grasses already present in the Study Area, leading to increased fire risk. Increased predators such as cats and dogs are a risk to Greater Sand Plover.	Moderate. Introduced species likely to be attracted to the Project are already well established in the Region, however, increased fire risk as a result of weedy grasses is a significant risk in the region.	Mortality of individuals Decline in population size	High – impacts by introduced species on migratory birds are well recorded, and introduced species are a threatening process for Greater Sand Plover.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula.	Long term (42 years)	Low. The Project has been allocated to the available land in a way that maximises the distance between the high noise and light sources and the Greater Sand Plover habitats. The	Negligible. The scale and magnitude of the impacts will not have an impact to	Displacement of individuals	Low. Impacts of noise and light have not been studied for this species and general data has inconsistent findings. Greater Sand

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
			Lighting around buildings operating 24 hours per day.		magnitude and scale of the impact is within the limits of previous projects where Greater Sand Plover has persisted. A vegetation buffer has been allocated to reduce the impact.	Greater Sand Plover in the broader region.	Reduced fitness	Plover persist in noisy areas but there is no specific knowledge of the physiological impact on fitness
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Moderate. Poorly rehabilitated land is prone to introduced species. These have risks of are spread of weedy grasses already present in the Study Area, leading to increased fire risk. Increased predators such as cats and dogs. Successful rehabilitation will provide improved hydrological function in currently disturbed areas that will benefit shorebird habitats.	Low. The impact would be contained to the Study Area.	Decline in population size	Moderate – impacts by introduced species on migratory birds are well recorded. Impacts of changes in hydrology to shorebird habitats are understood.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Saltpans and Mangroves are sensitive to changes in hydrological processes however the Project has been assessed as low risk of altering hydrological processes.	Low. Impacts would be at a local scale.	Changes in carrying capacity	High. Impacts of changes in hydrology to saltpan and mangrove habitats are understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Moderate. High intensity fire would have a detrimental local impact on habitat quality and prey availability through the decrease in water quality associated with ash being transported into the waterway.	Moderate. Fires inadvertently started at the Study Area may potentially escape and burn beyond the boundary and subsequently impact on the suitability of habitat in the region or the scale of the impact through ash load from the catchment.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	Medium. The extent to which the species habitat is impacted by fire is not well researched.
		Contamination of surface and groundwater	Local	Permanent	Medium. There is a medium risk of contamination of surface and groundwater as a result of the Project. This may reduce habitat quality for this species locally	Low. Impacts would be at a local scale	Decline in carrying capacity	
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. The risk of sedimentation as a result of the Project is low.	Low. Impacts would be at a local scale	Decline in carrying capacity	High. A Stormwater Management Plan has been prepared for the Project including guideline and Policy recommendations from the Darwin Harbour Advisory Committee
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Greater Sand Plover have been recorded at the Palmerston Sewerage Treatment Ponds and occur in nationally significant numbers at the East Arm Wharf indicating artificial habitats can be suitable. The water quality in the Ponds will not be harmful to Greater Sand Plover and ponds will be designed to be poor quality habitat to shorebirds.	Negligible. Strategies to reduce risk and detract shorebirds from open water storages are well established and effective.	Mortality or injury of individuals Decline in population size	High. Greater Sand Plover are known to inhabit artificial wetlands, but strategies to reduce risk and detract shorebirds from Ponds are well established.
Black-footed Tree-rat *Mesembriomys gouldii* EPBC Act: EN TPWC Act: VU	Confirmed	Habitat Loss	Local. 92.5 ha of Mixed Woodland habitat to be cleared in the Development Envelope including 3.7 ha of significant habitat (large trees)	Permanent	Moderate. The population within the survey area is most likely permanent, however the species is known to have a large home range (up to 67 ha), travel long distances (up to 2 km) and flexibility in denning habitats if Pandanus is available. 43 ha of Mixed Woodland will be retained in the Study Area and Black-footed Tree-rat have demonstrated an ability to persist in smaller habitat areas if they have connectivity to larger habitat patches (Rankmore 2006).	Low. The preferred habitat for the Black-footed Tree-rat is widespread in the Greater Darwin Region with the habitat loss associated with the Project being a 1.2% reduction in the Elizabeth and Blackmore Rivers Catchment area (DENR 2020). The impact is assessed as Low because loss of the habitat within the	Mortality or displacement of individuals Decline in population size Local extinction Reduction in the carrying capacity	High. Habitat loss is a threatening process for the Black-footed Tree-rat (Hill, 2012; TSSC, 2015b).

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
					A large area of intact high quality habitat known to support the species occurs to the east of the Project and animals displaced due to habitat loss associated with the Project will likely successfully translocate into the area. The habitats within the Study Area are currently highly fragmented internally by past disturbance, at risk from fire due to high grassy weed occurrence, and subject to high levels of human and introduced fauna disturbances. The local habitat loss is approximately 4% of the available habitats in central middle arm. The impact is assessed as Moderate because loss of the habitat within the Development Envelope would not be expected to compromise the viability of the local population in central middle arm, and the highly mobile individuals will likely relocate, but the impact is permanent.	Development Envelope would not be expected to compromise the viability of the Regional population.	of the local environment	
		Habitat Fragmentation	Local. Increased traffic on the Channel Island Road will present higher risk to animals crossing into intact habitats to the east	Long-term	High. The habitats available in Lot 1817 are already fragmented by disturbed areas. The further loss of habitat will increase the level of fragmentation between remnant habitat blocks. The Study Area is already fragmented from the intact habitats to the east by Channel Island Road and the railway line. The Project will increase traffic on these corridors by 14% however the majority of expected vehicle movement will occur in the day while this species is sleeping.	Low. The impact is assessed as Low because loss of the habitat within the Development Envelope would not be expected to compromise the viability of the Regional population.	Reduction in carrying capacity of the local environment Decline in population size	Moderate. The number of road fatalities of Black-footed Tree-rat on the Channel Island road is not systematically reported
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term Operation: Long term (40 years)	Construction - High. Without management measures there is a risk of serious or fatal injury to Black-footed Tree-rat from vehicle strike during clearing activities. As the species is nocturnal, clearing during the day may prohibit animals the opportunity to escape. This is short-term and the risk will cease once clearing has been completed – likely a few months following the start of construction. As the species is highly mobile it is likely to cross from retained habitats in the Study Area into the intact habitats east of the Channel Island Road and the rail line, however there is a risk of fatalities during crossing. Operations Low. The Project will increase traffic on Channel Island Road by 14% during operations however the majority of expected vehicle movement will occur in the day while this species is sleeping.	Low. Although the Project will increase vehicle traffic generally in the region, and thus increase the likelihood of roadkill, the number of individuals affected are likely to be low.	Mortality or injury of individuals Decline in population size	Moderate. The number of road fatalities of Black-footed Tree-rat on the Channel Island road is not systematically reported
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Moderate. Introduced species are already established in the locality and region, however introduced species are commonly found to be increasing in disturbed areas if not actively managed.	Low. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase.	Mortality of individuals Decline in population size	High. Introduced predators and the increased fire risk from weedy grasses are threatening processes for the Black-footed Tree-rat.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Medium. Black-footed Tree-rat are known to occur in the habitats around infrastructure developments on Middle Arm. They currently occupy habitats within 100 m of the Adelaide-Darwin Railway line, where noise source is highest. While they persist in these noisy areas, the impact of light on Black-footed Tree-rat is unknown. A vegetation buffer has been allocated around the Development Envelope that will limit the scale of impact .	Low. The impacts will be localised.	Displacement of individuals Disruption to breeding Reduced fitness	Moderate. No information is available on the impact of light on Black-footed Tree-rat. The species is known to occupy habitats in close proximity to existing industrial noise in the Middle Arm area, however no studies have been done on the physiological toll of noise.
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Moderate. The habitats within the Study Area that will be retained are currently fragmented by disturbed areas. The disturbed areas have a high frequency of introduced species and present a high fire risk. The risk is the lost opportunity to improve the quality of retained habitat.	Low. The impact will be localised.	Decline in population size	High. The effect of fragmented habitat on the Black-footed Tree-rat is understood. The impact of introduced species is understood.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Black-footed Tree-rat habitats are not reliant on the groundwater or surface water features of the Study Area. Failure to manage stormwater may result in some erosion and sedimentation within habitats but as they occupy the higher elevation areas this is unlikely.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Moderate. High intensity fire would have a detrimental local impact on denning availability and food availability through the decrease in vegetation structure and availability of food plants. Animals may be killed by the fire.	Moderate. Fires inadvertently started at the Study Area may potentially escape and burn beyond the boundary and subsequently impact on the suitability of habitat in the region. A high intensity fire in Middle Arm could jeopardise the local population of Black-footed Tree Rat.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. Inappropriate fire regime is a threatening process for Black-footed Tree-rat.
		Contamination of surface and groundwater	Local	Permanent	Low. Black-footed Tree-rat habitats are not expected to be impacted by pollution sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. Black-footed Tree-rat habitats are not expected to be impacted by erosion and sedimentation sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Black-footed Tree-rat are known to minimise time in disturbed habitats and avoid open areas. Whilst they will cross disturbed areas to reach habitat patches they are not known to use features within disturbed areas.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	High. Black-footed Tree-rat habitat preferences are understood.
Pale Field Rat *Rattus tunneyi* EPBC Act: Not listed TPWC Act: VU	Confirmed	Habitat Loss	Limited. No vegetation clearing will occur in Pale Field Rat habitat.	Permanent	None	None	None	High. No habitat suitable for the Pale Field Rat occurs within the Development Envelope
		Habitat Fragmentation	Local. No habitats will be fragmented	Permanent	Negligible. Suitable habitat for the species is patchily distributed within the riparian vegetation fringing the	No impact	None	High. No habitat suitable for the Pale Field Rat occurs within the Development Envelope, the habitat in the Study Area

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
					Elizabeth River. These habitats will remain connected by continuous vegetation and not fragmented by the Project.			remains connected to the similar patches via the riparian fringing vegetation.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term Operation: Long term (40 years)	Low. No vehicle movements are proposed in the construction or operation phase within the suitable habitat for Pale Field Rat. Connectivity to similar habitat does not require the species to cross the Channel Island Road as intact riparian vegetation connects patches on Middle Arm.	Low. Although the Project will increase vehicle traffic generally in the region, and thus increase the likelihood of roadkill, the number of individuals affected are likely to be low.	Mortality or injury of individuals Decline in population size	Moderate. The number of road fatalities of Pale Field Rat on the Channel Island road is not systematically reported
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Moderate. Introduced species are already established in the locality and region, however introduced species are commonly found to be increasing in disturbed areas if not actively managed.	Low. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase.	Mortality of individuals Decline in population size	High. Introduced predators and the increased fire risk (exacerbated by weedy grasses) are considered likely to be impacting the sustainability of the Pale Field Rat population in the NT.
		Noise and Light	Local. Construction: rehabilitation activities and infrastructure on the northern peninsula. Operation: Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Construction: Short term Operation: Long term (42 years)	Low. Short term impacts from noise during rehabilitation of land will occur 100 m from the suitable habitat. These activities are likely to be completed within a few months of construction commencement. Operations noise sources will be concentrated to the southern peninsula 2.5 km from the suitable habitat. Lighting from the northern peninsula will be buffered by 200 m of vegetation.	Low. The impacts will be localised.	Displacement of individuals Disruption to breeding Reduced fitness	Low. No information is available on the impact of light on Pale Field Rat.
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Moderate. Disturbed areas have a high frequency of introduced species and present a high fire risk. The risk is the lost opportunity to improve the quality of retained habitat to reduce the risk of introduced species.	Low. The impact will be localised.	Decline in population size	High. Increased fire risk (exacerbated by weedy grasses) is considered likely to be impacting the sustainability of the Pale Field Rat population in the NT.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Pale Field Rat prefer habitats with surface water features. Failure to manage stormwater may result in loss of surface drainage to the suitable habitat and erosion and sedimentation within drainage feature habitats. However, the areas surrounding the suitable habitat are highly disturbed and natural drainage features are highly altered. The catchment for the area is very small and changes are likely to have a small impact. The Project has been assessed as having a low risk of impact to hydrological processes.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The surface hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Moderate. High intensity fire would have a detrimental local impact on denning availability and food availability through the decrease in vegetation structure and availability of food plants. Animals may be killed by the fire.	Moderate. Fires inadvertently started at the Study Area may potentially escape and burn beyond the boundary and subsequently impact on the suitability of habitat in the region. A high intensity fire in Middle Arm could jeopardise the	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. Introduced predators are considered likely to be impacting the sustainability of the Pale Field Rat population in the NT.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
						local population of Black-footed Tree Rat.		
		Contamination of surface and groundwater	Local	Permanent	Low. Pale Field Rat habitats are not expected to be impacted by pollution sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. Pale Field Rat habitat may be impacted by erosion and sedimentation sources from the Project in the construction phase specifically from the rehabilitation areas within the catchment. Following management of stormwater in accordance with the Stormwater Management Plan the risk of sedimentation as a result of the Project is low.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Pale Field Rat habitat is 200 m from the Development Envelope and the species prefers densely vegetated environments.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	Moderate. Pale Field Rat habitat preferences are understood but little is know of the attraction to water storages.
Red Knot *Calidris ferruginea* EPBC Act: VU Mi TPWC Act: EN Curlew Sandpiper *Calidris ferruginea* EPBC Act: CR, Mi TPWC Act: VU Great Knot *Calidris tenuirostris* EPBC Act: VU, Mi TPWC Act: CR Lesser Sand Plover *Charadrius mongolus* EPBC Act: VU, Mi TPWC Act: EN Bar-tailed Godwit Limosa lapponica EPBC Act: VU, Mi TPWC Act: Not listed EPBC Act Mi Shorebird Species	Likely	Habitat Loss	Limited. No vegetation clearing will occur in Shorebird Habitat	Permanent	No impact	No impact	None	High. No habitat suitable for Shorebirds occurs within the Development Envelope
		Habitat Fragmentation	Local. No habitats will be fragmented	Permanent	Negligible. The Project does not fragment any shorebird habitats, or decrease the connectivity of local habitats	Negligible. The Project does not fragment any shorebird habitats, or decrease the connectivity of regional habitats	None	High. The Project occurs on the margin of shorebird habitat and does not interrupt the connectivity of habitats within the Darwin Harbour.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term (2 years) Operation: Long term (40 years)	Low – Vehicles are not expected to occur in the shorebird habitat. During rehabilitation works in the construction period earthmoving vehicles may work in close proximity (within 50 m) of mangrove habitat but this is likely to be of very short duration (a few days). Most construction activity will be in excess of 200 m from shorebird habitat. Shorebirds are unlikely to be active near the Channel Island Road or Adelaide-Darwin Railway line as no suitable habitat is present. Human disturbance will decrease due to the restricted public access	Negligible – there is unlikely to be a significant impact to this species due to human disturbance or vehicle strike in the broader region.	Mortality or injury of individuals Decline in population size	High – the effects of human disturbance on migratory shorebirds is well established
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Moderate. Potential impacts of introduced species are spread of weedy grasses already present in the Study Area, leading to increased fire risk. Increased predators such as cats and dogs are a risk to most shorebirds.	Moderate. Introduced species likely to be attracted to the Project are already well established in the Region, however, increased fire risk as a result of weedy grasses is a significant risk in the region.	Mortality of individuals Decline in population size	High – impacts by introduced species on migratory birds are well recorded and invasive species are a threatening process for these shorebird species.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Low. The Project has been allocated to the available land in a way that maximises the distance between the high noise and light sources and the Shorebird habitats. The magnitude and scale of the impact is within the limits of previous projects where these shorebird species have	Negligible. The scale and magnitude of the impacts will not have an impact to Shorebird species in the broader region.	Displacement of individuals Reduced fitness	Low. Impacts of noise and light have not been studied for this species and general data has inconsistent findings. These shorebird species persist in noisy areas but

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
Sharp-tailed Sandpiper (*Calidris acuminata)* Pectoral Sandpiper (*Calidris melanotos)* Oriental pranticole *(Glareola maldivarum)* Oriental Plover *(Charadrius veredus)* Ruddy turnstone (*Arenaria interpres*) Sanderling (*Calidris alba*) Red-necked Stint (*Calidris ruficollis*) Long-toed Stint (*Calidris subminuta*) Little Ringed Plover (*Charadrius dubius*) Asian Dowitcher (*Limnodromus semipalmatus*) Black-tailed Godwit (*Limosa limosa*) Little Curlew (*Numenius minutus*) Pacific Golden Plover (*Pluvialis fulva*) Grey Plover (*Pluvialis squatarola*) Wood Sandpiper (*Tringa glareola*) Marsh Sandpiper (*Tringa stagnatilis*) Terek Sandpiper (*Xenus cinereus*)					persisted. A vegetation buffer has been allocated to reduce the impact.			there is no specific knowledge of the physiological impact on fitness
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Moderate. Poorly rehabilitated land is prone to introduced species. These have risks of spreading of weedy grasses already present in the Study Area, leading to increased fire risk. Increased predators such as cats and dogs. Successful rehabilitation will provide improved hydrological function in currently disturbed areas that will benefit shorebird habitats.	Low. The impact would be contained to the Study Area.	Decline in population size	High. No impact to Shorebird habitat.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Saltpans and Mangroves are sensitive to changes in hydrological processes, however the Project has been assessed as having a low risk to hydrological processes.	Low. Impacts would be at a local scale.	Changes in carrying capacity	High. Impacts of changes in hydrology to saltpan habitats are understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Moderate. High intensity fire would have a detrimental local impact on habitat quality and prey availability through the decrease in water quality associated with ash being transported into the waterway.	Moderate. Fires inadvertently started at the Study Area may potentially escape and burn beyond the boundary and subsequently impact on the suitability of habitat in the region or the scale of the impact through ash load from the catchment.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	Medium. The extent to which the species habitat is impacted by fire is not well researched.
		Contamination of surface and groundwater	Local	Permanent	Medium. There is a medium risk of contamination of surface and groundwater as a result of the Project. This may reduce habitat quality for these species locally	Low. Impacts would be at a local scale.	Decline in carrying capacity	
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. The risk of sedimentation as a result of the Project is low.	Low. Impacts would be at a local scale.	Decline in carrying capacity	High. A Stormwater Management Plan has been prepared for the Project including guideline and Policy recommendations from the Darwin Harbour Advisory Committee
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Many of these shorebird species have been recorded at the Palmerston Sewerage Treatment Ponds and/or East Arm Wharf. The water quality in the Ponds will not be harmful to Shorebirds and ponds will be designed to be poor quality habitat to shorebirds.	Negligible. Strategies to reduce risk and detract shorebirds from open water storages are well established and effective.	Mortality or injury of individuals Decline in population size	High. Shorebirds are known to inhabit artificial wetlands, but strategies to reduce risk and detract shorebirds from Ponds are well established.
Northern Quoll *Dasyurus hallucatus* EPBC Act: CR	Likely	Habitat Loss	Local. 92.5 ha of Mixed Woodland habitat to be cleared in the Development Envelope including 3.7 ha	Permanent	Low. Lot 1817 does not contain critical habitat for, or an important population of, Northern Quoll as defined in CoA (2016). Loss of suitable habitat may reduce area used for occasional foraging, however scarcity of records on the	Low. The preferred habitat for the Northern Quoll is widespread in the Greater Darwin Region with the habitat loss associated with the Project being a	Reduction in the carrying capacity of the local environment	High. Habitat loss is a threatening process for the Northern Quoll

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
TPWC Act: EN			of significant habitat (large trees)		Middle Arm indicates use of this are by Northern Quoll is infrequent.	1.2% reduction in the Elizabeth and Blackmore Rivers Catchment area (DENR 2020).		
		Habitat Fragmentation	Local. Increased traffic on the channel Island Road will present higher risk to animals crossing into intact habitats to the east	Long-term	Low. The Study Area is already fragmented from the intact habitats to the east by Channel Island Road and the railway line. The Project will increase traffic on these corridors by 14%. The majority of traffic will be during the day when this species is asleep. This is a Low increase to the fragmentation already existing. No Northern Quoll are known to occupy the Study Area and the highly mobile species is likely to not be impeded by the crossing, but may be susceptible to increased risk of vehicle strike (addressed below).	Negligible. The regional habitat will not be fragmented.	Reduction in carrying capacity	High: The mobility of Northern Quoll is understood.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term Operation: Long term (40 years)	Low. There is a small risk of serious or fatal injury to Northern Quoll from vehicle strike during clearing activities, if the species has moved into the area recently. As the species is nocturnal, clearing during the day may prohibit animals the opportunity to escape. This is short-term and the risk will cease once clearing has been completed – likely a few months following the start of construction. As the species is highly mobile, if it visits the Study Area, it is likely to cross from retained habitats in the Study Area into the intact habitats east of the Channel Island Road and the rail line. There is a risk of fatalities during crossing.	Low. Although the Project will increase vehicle traffic generally in the region, and thus increase the likelihood of roadkill, the number of individuals affected are likely to be low.	Mortality or injury of individuals Decline in population size	Moderate. The number of road fatalities of Northern Quoll on the Channel Island road is not systematically reported
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Low. Introduced species are already established in the locality and region, however introduced species are commonly found to be increasing in disturbed areas if not actively managed. Northern Quoll are susceptible to death by ingesting Cane Toads. Cane toad habitat will be reduced as a result of the Project.	Low. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase.	Mortality of individuals Decline in population size	High. Introduced species (particularly Cane Toads) and the increased fire risk from weedy grasses are threatening processes for the Northern Quoll.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Low. Northern Quoll are known to persist in inhabited areas including industrial sites. The have been known to use infrastructure for denning and benefit from increased concentration insects due to lighting. This can have a negative impact as the close interaction with humans and often vehicles and machinery may cause serious injury and death. The low occurrence of the species locally indicates the Project is unlikely to attract or impact Northern Quoll due to noise and light.	Low. The impacts will be localised.	Displacement of individuals Reduced fitness	High. Interaction with Northern Quoll in industrial sites is understood.
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Low. Disturbed areas have a high frequency of introduced species and present a high fire risk. The risk is the lost opportunity to improve the quality of retained habitat.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Northern Quoll that are inhabiting intact habitats to the east.	Decline in population size	High. Inappropriate fire regime is a threatening process for Northern Quoll

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
					The low number of records of Northern Quoll in the area indicate the impact would be limited.			
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Northern Quoll potential habitats are not reliant on the groundwater or surface water features of the Study Area. Failure to manage stormwater may result in some erosion and sedimentation within habitats but as they occupy the higher elevation areas this is unlikely.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Low. High intensity fire would have a detrimental local impact on denning availability and food availability through the decrease in vegetation structure and availability of food plants. Animals may be killed by the fire. The low number of records of Northern Quoll in the area indicate the impact would be limited.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Northern Quoll that are inhabiting intact habitats to the east.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. Inappropriate fire regime is a threatening process for Northern Quoll
		Contamination of surface and groundwater	Local	Permanent	Low. Northern Quoll habitats are not expected to be impacted by pollution sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. Northern Quoll habitats are not expected to be impacted by erosion and sedimentation sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Northern Quoll are known to visit industrial sites and residential areas but are not known to become entrapped in ponds or fences. The low number of records of Northern Quoll in the area indicate the impact would be limited.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	High. Interaction with Northern Quoll in industrial sites is understood.
Yellow Spotted Monitor *Varanus panoptes* EPBC Act: VU TPWC Act: Not Listed	Likely	Habitat Loss	Local. 270 ha. All habitat types are likely to be suitable for the species.	Permanent	Low. The Yellow Spotted Monitor is not known to occur in the Study Area and lack of records on the Middle Arm indicates use of this area is infrequent.	Low. The preferred habitat for the Yellow Spotted Monitor is widespread in the Greater Darwin Region	Reduction in the carrying capacity of the local environment	High. Significant survey effort in Middle Arm has not recorded Yellow Spotted Monitor.
		Habitat Fragmentation	Local. Increased traffic on the channel Island Road will present higher risk to animals crossing into intact habitats to the east	Long-term	Low. The Study Area is already fragmented from the intact habitats to the east by Channel Island Road. The Project will increase traffic by 14%. This is a Low increase to the fragmentation already existing. The Yellow Spotted Monitor is not known to occur in the Study Area and lack of records on the Middle Arm indicates use of this area is infrequent. The species is highly mobile and not likely to be impacted by fragmentation of the site.	Negligible. The regional habitat will not be fragmented.	Reduction in carrying capacity	High: The mobility of Yellow Spotted Monitor is understood.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel	Construction: Short term Operation: Long term (40 years)	Low. There is a small risk of serious or fatal injury to Yellow Spotted Monitor from vehicle strike during clearing activities, if the species has moved into the area recently. As the species is diurnal, clearing during the day will enable animals the opportunity to escape. This is short-term and the risk will cease once clearing has been completed – likely a few months following the start of construction.	Low. Although the Project will increase vehicle traffic generally in the region, and thus increase the likelihood of roadkill, the number of individuals affected are likely to be low.	Mortality or injury of individuals Decline in population size	Moderate. The number of road fatalities of Yellow Spotted Monitor on the Channel Island road is not systematically reported

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
			Island Road and Adelaide-Darwin Railway		As the species is highly mobile, if it visits the Study Area, it is likely to cross from retained habitats in the Study Area into the intact habitats east of the Channel Island Road and the rail line. There is a risk of fatalities during crossing.			
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Low. Introduced species are already established in the locality and region, however introduced species are commonly found to be increasing in disturbed areas if not actively managed. Poisoning from Cane Toads is the primary cause of decline in Yellow Spotted Monitor populations. Cane toad habitat will be reduced as a result of the Project.	Low. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase.	Mortality of individuals Decline in population size	High. Cane Toads are a the primary cause of decline in Yellow Spotted Monitor populations.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Negligible. The low occurrence of the species locally indicates the Project is unlikely to impact Yellow Spotted Monitor due to noise and light.	Negligible. Impacts will be localised.	Displacement of individuals Disruption to breeding Reduced fitness	High. Significant survey effort in Middle Arm has not recorded Yellow Spotted Monitor.
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Low. Disturbed areas have a high frequency of introduced species and present a high fire risk. The risk is the lost opportunity to improve the quality of retained habitat. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Yellow Spotted Monitor that are inhabiting intact habitats to the east.	Decline in population size	High. The impact of high intensity fire on fauna habitats is understood.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. The species has very generalist requirements and is not specifically dependant on habitats supported by hydrological processes. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Low. High intensity fire would have a detrimental local impact on food availability through the decrease in vegetation structure and availability of prey. Animals may be killed by the fire. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Yellow Spotted Monitor that are inhabiting intact habitats to the east.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. The impact of high intensity fire on fauna habitats is understood.
		Contamination of surface and groundwater	Local	Permanent	Low. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	High.
Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus nudicluniatus* EPBC Act: Not Listed TPWC Act: VU	Likely	Habitat Loss	Local. 92.5 ha of Mixed Woodland habitat to be cleared in the Development Envelope including 3.7 ha of significant habitat (large trees)	Permanent	Moderate. The Bare-rumped Sheath-tailed Bat has not been recorded in the Study Area, however recent survey by DEWPS has located the species as present on Middle Arm. The species requires tree hollows for denning during the day. These are highly restricted in the Study Area and competition for tree hollows is considered a threatening process for the species. Habitat loss is also a threatening process. As the species is nocturnal, daytime clearing risks that animals will not have the opportunity to escape. If given the opportunity to escape, the species will be able to relocate to the large intact habitat to the east.	Low. The preferred habitat for the Bare-rumped Sheath-tailed Bat is widespread in the Greater Darwin Region with the habitat loss associated with the Project being a 1.2% reduction in the Elizabeth and Blackmore Rivers Catchment area (DENR 2020). A large area of intact habitat exists to the east and is likely to have a greater availability of tree hollows.	Reduction in the carrying capacity of the local environment	High. Habitat loss is a threatening process for the Bare-rumped Sheath-tail Bat
		Habitat Fragmentation	Local. Increased traffic on the channel Island Road will present higher risk to animals crossing into intact habitats to the east	Long-term	Low. Habitat fragmentation is listed as a threatening process for the Bare-rumped Sheath-tail bat however, the species is highly mobile and is not inhibited by the road and rail network between the study site and the large intact habitat to the east.	Negligible. The regional habitat will not be fragmented.	None	High: The mobility of the species is understood.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term Operation: Long term (40 years)	Construction - High. Without management measures there is a risk of serious or fatal injury to Bare-rumped Sheath-tailed Bat from vehicle strike during clearing activities. As the species is nocturnal, clearing during the day may prohibit animals the opportunity to escape. This is short-term and the risk will cease once clearing has been completed – likely a few months following the start of construction. The scale is limited to the hollow bearing trees within the clearing area. As the species is highly mobile it is likely to cross from retained habitats in the Study Area into the intact habitats east of the Channel Island Road and the rail line Operations Negligible.	Negligible. The species flies high in the sky for feeding	Mortality or injury of individuals Decline in population size	High. The behaviour of the species is understood.
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Low. Introduced species are already established in the locality and region. The Bare-rumped Sheath-tailed bat is not known to be susceptible to introduced species. Weedy grasses increase fire risk, which may impact the species habitat in Middle Arm.	Moderate. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase. Increased fire risk may impact the species in the region.	Mortality of individuals Decline in population size	High. The increased fire risk from weedy grasses is understood.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula.	Long term (42 years)	Low. The Bare-rumped Sheath-tailed Bat is known to tolerate some disturbances.	Low. The impacts will be localised.	Displacement of individuals	Moderate. Data on tolerance to disturbance is not from the local area.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
			Lighting around buildings operating 24 hours per day.				Disruption to breeding Reduced fitness	
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Low. Availability of tree hollows is the limiting factor for habitat suitability for this species. Rehabilitated land is unlikely to provide significant habitat quality to the Bare-Rumped Sheath-tail Bat for many hundreds of years. Significant intact habitat occurs to the east of the Study Area and unavailability of the rehabilitation areas as habitat will not impact the species. Poorly rehabilitated land has a high risk of fire due to the presence of weedy grasses.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Bare-rumped Sheath-tailed Bat that are inhabiting intact habitats to the east.	Decline in population size	High. Inappropriate fire regime that reduces the availability of tree hollows is a threatening process for the Bare-rumped Sheath-tail Bat.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Negligible. Bare-rumped Sheath-tail Bat potential habitats are not reliant on the groundwater or surface water features of the Study Area.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Low. High intensity fire would have a detrimental local impact on denning availability and food availability through the decrease in vegetation structure and availability of food plants. Animals may be killed by the fire.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Bare-rumped Sheath-tailed Bat that are inhabiting intact habitats to the east.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. Inappropriate fire regime that reduces the availability of tree hollows is a threatening process for the Bare-rumped Sheath-tail Bat.
		Contamination of surface and groundwater	Local	Permanent	Low. Bare-rumped Sheath-tail Bat habitats are not expected to be impacted by pollution sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. Bare-rumped Sheath-tail Bat habitats are not expected to be impacted by erosion and sedimentation sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Bats in general are known to be sensitive to barbed wire fences and can become entangled whilst feeding. The Bare-rumped Sheath-tail Bat is known to forage at heights above the ground that make them less susceptible to this threat.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	High. Feeding behaviour of the Bare-rumped Sheath-tail Bat is understood.
Fawn Antechinus *Antechinus bellus* EPBC Act: EN TPWC Act: VU	Possible	Habitat Loss	Local. 92.5 ha of Mixed Woodland habitat to be cleared in the Development Envelope including 3.7 ha of significant habitat (large trees)	Permanent	Low. The Fawn Antechinus has not been recorded in the Study Area, however NT Fauna Atlas records the species as present on Middle Arm. The species requires tree hollows for denning. These are highly restricted in the Study Area and competition for tree hollows may be one of the reasons the species is not present. Habitat loss is a threatening process for the species.	Low. The preferred habitat for the Fawn Antechinus is widespread in the Greater Darwin Region with the habitat loss associated with the Project being a 1.2% reduction in the Elizabeth and Blackmore Rivers Catchment area (DENR 2020). A large area of intact habitat exists to the east and is likely to have a greater availability of tree hollows.	Reduction in the carrying capacity of the local environment	High. Habitat loss is a threatening process for the Fawn Antechinus

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
					As the species is crepuscular, daytime clearing risks that animals will not have the opportunity to escape. If given the opportunity to escape, suitable habitat exists in the intact habitat to the east.			
		Habitat Fragmentation	Local. Increased traffic on the channel Island Road will present higher risk to animals crossing into intact habitats to the east	Long-term	Low. The species is not known to occur within the Study Area. The Study Area is already fragmented from the intact habitats to the east due to the Channel Island Road and Adelaide-Darwin Railway Line.	Negligible. The regional habitat will not be fragmented.	Reduction in carrying capacity	High. The species has not been recorded in 3 systematic surveys.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term Operation: Long term (40 years)	Low. The species is not known to occur within the Study Area.	Low. Although the Project will increase vehicle traffic generally in the region, and thus increase the likelihood of roadkill, the number of individuals affected are likely to be low.	Mortality or injury of individuals Decline in population size	Low. Systematic recording of mortality of this species from vehicle strike is not available.
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Low. Introduced species are already established in the locality and region. The Fawn Antechinus is at risk from introduced predators, particularly cats. It is also susceptible to death from ingesting toxic cane toads. Cane toad habitat will be reduced as a result of the Project. Weedy grasses increase fire risk, which may impact the species habitat in Middle Arm.	Moderate. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase. Increased fire risk may impact the species in the region.	Mortality of individuals Decline in population size	High. The increased fire risk from weedy grasses is understood.
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Low. The species is not known to occur within the Study Area.	Negligible. The impacts will be localised.	Displacement of individuals Disruption to breeding Reduced fitness	Moderate. Data on tolerance to disturbance is not from the local area.
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Low. Poorly rehabilitated land has a high risk of fire due to the presence of weedy grasses and is likely to support introduced fauna such as cats and cane toads.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Fawn Antechinus that are inhabiting intact habitats to the east.	Decline in population size	High. Inappropriate fire regime that reduces the availability of tree hollows is a threatening process for the Fawn Antechinus.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. Fawn Antechinus potential habitats are not reliant on the groundwater or surface water features of the Study Area.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Low. High intensity fire would have a detrimental local impact on denning availability and food availability through the decrease in vegetation structure and availability of food plants. Animals may be killed by the fire.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Fawn Antechinus that are inhabiting intact habitats to the east.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. Inappropriate fire regime that reduces the availability of tree hollows is a threatening process for the Fawn Antechinus.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
		Contamination of surface and groundwater	Local	Permanent	Low. Fawn Antechinus habitats are not expected to be impacted by pollution sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. Fawn Antechinus habitats are not expected to be impacted by erosion and sedimentation sources from the Project.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. Fawn Antechinus is not known to occur within the Study Area.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	High. The species has not been recorded in 3 systematic surveys.
Mertens' Water Monitor *Varanus mertensi* EPBC Act: VU TPWC Act: Not listed	Possible	Habitat Loss	Limited. 11.7 ha. Temporary water bodies in disturbed areas.	Permanent	Low. The Mertens' water Monitor is not known to occur in the Study Area and lack of records on the Middle Arm indicates use of this area is infrequent. The potentially suitable habitat is all previously disturbed and the actual suitability is not known. Possibly the species does not occur at the site because of the poor quality of available habitat. Prior to disturbance the habitat was Woodland, and not expected to contain suitable habitat for the species.	Negligible. The loss of artificial and unproven habitat has no regional impact.	Reduction in the carrying capacity of the local environment	High. Significant survey effort in Middle Arm has not recorded Mertens' Water Monitor.
		Habitat Fragmentation	Local. Increased traffic on the channel Island Road will present higher risk to animals crossing into intact habitats to the east	Long-term	Low. The Study Area is already fragmented from the intact habitats to the east by Channel Island Road. The Project will increase traffic on these corridors by 14%. This is a Low increase to the fragmentation already existing. The Mertens' Water Monitor is not known to occur in the Study Area and lack of records on the Middle Arm indicates use of this area is infrequent. The species is highly mobile and not likely to be impacted by fragmentation of the site.	Negligible. The regional habitat will not be fragmented.	Reduction in carrying capacity	High: The mobility of Mertens' Water Monitor is understood.
		Human disturbance and vehicle strike	Local. Construction: Vegetation clearing and rehabilitation activities Local. Operation: Increased traffic on the Channel Island Road and Adelaide-Darwin Railway	Construction: Short term Operation: Long term (40 years)	Low. There is a small risk of serious or fatal injury to Mertens' Water Monitor from vehicle strike during clearing activities, if the species has moved into the area recently. As the species is diurnal, clearing during the day will enable animals the opportunity to escape. This is short-term and the risk will cease once clearing has been completed – likely a few months following the start of construction. As the species is highly mobile, if it visits the Study Area, it is likely to cross from retained habitats in the Study Area into the intact habitats east of the Channel Island Road and the rail line. There is a risk of fatalities during crossing.	Low. Although the Project will increase vehicle traffic generally in the region, and thus increase the likelihood of roadkill, the number of individuals affected are likely to be low.	Mortality or injury of individuals Decline in population size	Moderate. The number of road fatalities of Mertens' Water Monitor on the Channel Island road is not systematically reported
		Introduced species	Local. Predominantly in and around disturbed areas	Permanent	Low. Introduced species are already established in the locality and region, however introduced species are commonly found to be increasing in disturbed areas if not actively managed. Poisoning from Cane Toads is the primary cause of decline in Mertens' Water Monitor populations. Cane toad habitat will be reduced as a result of the Project.	Low. Any introduced species likely to occur as a result of the Project are already established in the region. The Project is unlikely to cause any significant increase.	Mortality of individuals Decline in population size	High. Cane Toads are a the primary cause of decline in Mertens' Water Monitor populations.

Species	Likelihood of occurrence	Impact source	Scale	Duration	Impact			
					Intensity (Local)	Intensity (Regional)	Potential consequence of impact	Certainty (Level of confidence)
		Noise and Light	Local. Concentrated within the infrastructure allocated to the southern peninsula. Lighting around buildings operating 24 hours per day.	Long term (42 years)	Negligible. The low occurrence of the species locally indicates the Project is unlikely to impact Mertens' Water Monitor due to noise and light.	Negligible. Impacts will be localised.	Displacement of individuals Disruption to breeding Reduced fitness	High. Significant survey effort in Middle Arm has not recorded Mertens' Water Monitor.
		Inappropriate or ineffective rehabilitation	Local. 64 ha of land to be rehabilitated	Permanent	Low. Disturbed areas have a high frequency of introduced species and present a high fire risk. The risk is the lost opportunity to improve the quality of retained habitat. The low number of records of Yellow Spotted Monitor in the area indicate the impact would be limited.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Mertens' Water Monitor that are inhabiting intact habitats to the east.	Decline in population size	High. The impact of high intensity fire on fauna habitats is understood.
		Altered hydrological processes	Local. Extent of existing and future water sources	Permanent	Low. The species has very specialist requirements and is specifically dependant on habitats supported by hydrological processes. The low number of records of Mertens' Water Monitor in the area indicate the impact would be limited, and the available habitat may be of poor quality and not capable of supporting the species.	Negligible. The catchment for the Study Area is very small and drains directly to the adjacent River. Changes will have no impact to this species on a regional scale.	Changes in carrying capacity	High. The hydrology of the Study Area is understood.
		Uncontrolled fire	Limited to Regional. Extent of disturbance from fire in habitat areas	Long term (40 years)	Low. High intensity fire would have a detrimental local impact on food availability through the decrease in vegetation structure and availability of prey. Animals may be killed by the fire. The low number of records of Mertens' Water Monitor in the area indicate the impact would be limited.	Moderate. The risk of uncontrolled fire is a significant risk to the region and Mertens' Water Monitor that are inhabiting intact habitats in the region.	Mortality or injury of individuals Decline in population size Reduction in carrying capacity	High. The impact of high intensity fire on fauna habitats is understood.
		Contamination of surface and groundwater	Local	Permanent	Low. The low number of records of Mertens' Water Monitor in the area indicate the impact would be limited.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Erosion and sedimentation	Extent of ground disturbance during construction	Short term (2 years)	Low. The low number of records of Mertens' Water Monitor in the area indicate the impact would be limited.	Negligible. Impacts are expected to be localised and will not impact the regional population.	Decline in carrying capacity	High.
		Ponds and fauna entrapment	Limited. Open water and fencing within the Development Envelope	Long term (40 years)	Low. The Ponds may represent suitable habitat for the species, however there is unlikely to be prey available so the quality of the habitat would be poor. The low number of records of Mertens' Water Monitor in the area indicate the impact would be limited.	Negligible. Impacts are expected to be limited and will not impact the regional population.	Mortality or injury of individuals Decline in population size	Low. The appeal of Ponds to Mertens' Water Monitor is unknown.

7 APPLICATION OF THE MITIGATION HEIRACHY

Management of impact sources can mitigate the risk to significant fauna and fauna habitat. The EP Act Part 2 Section 26(1) sets out the Environmental Decision Making Hierarchy. In making decisions in relation to actions that affect the environment, the following hierarchy of approaches in order of priority must be applied:

(a) Ensure that actions are designed to avoid adverse impacts on the environment;
(b) Identify management options to mitigate adverse impacts on the environment to the greatest extent practicable;
(c) If appropriate, provide for environmental offsets in accordance with the Act for residual adverse impacts on the environment that cannot be avoided or mitigated.

Table 7-1 lists the proposed mitigation and management strategies for each impact source potentially arising from the Project. Many of the mitigation strategies were identified in the Draft EIS. The supplementary mitigations have been identified.

Table 7-1. Mitigation and management strategies for each impact source potentially arising from the Project.

Impact source	Mitigation Hierarchy	Mitigation and management strategy
Draft EIS		
Vegetation clearing resulting in loss of fauna	Avoid/Minimise	• Implement the Ground Disturbance and Vegetation Clearing Procedures (EP-05) within the Environmental Management Plan (EMP), including: Pre-clearance fauna trapping and translocation.
Vegetation clearing resulting in loss of fauna habitat	Avoid/minimise	• Ensure habitat to be cleared is well represented elsewhere on the Middle Arm Peninsula, and in the region. • Implement the Ground Disturbance and Vegetation Clearing Procedures (EP-05) within the EMP including: • Development and implementation of an internal Ground Disturbance Permit system, whereby no land clearing is undertaken without completing a series of checks to ensure: o The proposed clearing has been approved; o Conditions in relation to fauna clearing and other requirements have been assigned. Approved permits are assessed for compliance with permit conditions.
Habitat fragmentation	Avoid/minimise	Site layout design to be compact and reduce areas of habitat fragmentation where possible
Uncontrolled fire causing loss of individuals and habitat destruction	Avoid	• Implementation of the Fire Management Plan (**FMP**) including: o Site personnel will be trained in fire protection; o The site will be equipped with fire extinguishers and other fire prevention measures; and o A hot work permit system will be implemented; o Grassy weeds will be controlled
Vehicle strike Construction Earthworks	Avoid/minimise	Implement the Ground Disturbance and Vegetation Clearing Procedures (EP-05) within the Environmental Management Plan (EMP), including: • Pre-clearance fauna trapping and translocation. • Presence of a fauna spotter/catcher during clearing
Vehicle strike Construction and Operations	Avoid/minimise	• Maintain suitable speed limits. • Erect warning signs in any locations where fauna are regularly sighted. • Ensure employee and local contractor awareness of local fauna and encourage reporting of sightings and any incidents of vehicle strike.

Increase in the abundance of introduced fauna	Minimise	• Ensure all putrescible waste is securely stored until removed from site • Monitor sightings of feral fauna and undertake control measures in consultation with stakeholders.
Lighting, noise and vibrations altering natural behaviour	Minimise	All light sources will be aimed towards work areas and away from surrounding habitat, using light shields as necessary to minimise light spill.
Fauna entrapment in infrastructure	Avoid, minimise	• Fence settling ponds o Install fauna egress points in water storage dams and / or sumps • Ensure vegetation around barbed wire fences is kept to a minimum • Avoid the use of barbed wire in fences where possible. • Barbed wire fences will be inspected for trapped animals (particularly bats)and mitigation measures explored if a problem is identified
Alteration and sedimentation of surface water flows and water quality from erosion.	Minimise	Implementation of the Stormwater Management Plan (EIS Supplement Appendix C) and Implementation of the Water Management Procedure (EP-07) contained within the EMP (Appendix M) including: • Use of sediment basins where required; and • Use of a dedicated stormwater management system during operations. • Maintain natural flow paths wherever possible.
Supplementary		
Fragmentation	Minimise	Minimise the impact of fragmentation through rehabilitation of disturbed areas identified in the Rehabilitation Management Plan.
Inappropriate or ineffective rehabilitation	Avoid	Implementing a monitoring program detailed in the Rehabilitation Management Plan to identify issues and management actions triggered by quantitative thresholds Avoid the spread of weedy grasses by having an objective of eradication
Lightning and uncontrolled fire	Avoid	The Fire Management Plan (FMP) (EIS Supplement Appendix N) has been updated to include the eradication of gamba grass
Ponds and fauna entrapment	Avoid	Avoid attracting fauna to settling ponds by engineering settling ponds to have steep raised embankments with no edges

8 RESIDUAL RISK ASSESMENT

Risk has been assessed using the framework described in the EIS Supplement Appendix Q for the potential impacts to Significant Fauna. In **Table 8-1** risk ratings are provided for the activity both without (initial) and with (residual) mitigation allowing the effect of the mitigation measures to be understood. As the risk differs on a species by species basis (as detailed in Section 6.3.3), the highest risk category experienced for any particular species has been adopted for each impact.

Table 8-1. Residual risk assessment

Environmental Aspect	Risk Pathways	Impacts	Initial (pre-mitigation)			Residual (post mitigation)			Level of Certainty
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Residual Risk Rating	
Construction of processing facility	Vegetation clearing	• Mortality or displacement of individuals • Decline in population size • Local extinction • Reduction in the carrying capacity of the environment, or a reduction in the species or individuals that the environment can support • Reduction in diversity	5	2	Medium	2	2	Low	High
Construction and operations activities	Habitat fragmentation	• Decline in population size • Reduction in the carrying capacity of the environment, or a reduction in the species or individuals that the environment can support • Reduced reproductive success • Reduction in diversity	4	2	Medium	2	2	Low	High
Construction	Vehicle strike	• Mortality or injury of individuals • Decline in population size	4	3	Medium	2	2	Low	Moderate
Operations			2	2	Low	1	2	Low	
Construction and processing activities, and associated human use and waste production	Increase in abundance of introduced species	• Mortality of individuals • Decline in population size	3	3	Medium	1	3	Low	High

Construction and operations activities	Increased noise and light	• Displacement of individuals • Disruption to breeding • Reduced fitness	3	2	Medium	2	2	Low	Medium
Construction	Inappropriate or ineffective rehabilitation	• Decline in population size	3	3	Medium	1	3	Low	High
Construction and operations activities	Altered Hydrology	• Changes in carrying capacity	2	2	Low	2	2	Low	High
Construction and operations activities	Uncontrolled fire	• Mortality or injury of individuals • Decline in population size • Reduction in carrying capacity • Changes in species • Reduction in faunal diversity	3	3	Medium	1	3	Low	High
Construction and operations activities	Contamination of surface and groundwater	• Decline in carrying capacity • Changes in species • Reduction in faunal diversity	3	2	Medium	2	2	Low	High
Construction and operations activities	Erosion and sedimentation	• Reduction in carrying capacity • Changes in species • Reduction in faunal diversity	2	2	Low	2	2	Low	High
Earthworks and infrastructure construction and operation.	Fauna entrapment in infrastructure	• Mortality or injury of individuals • Decline in population size	4	2	Low	2	2	Low	High

9 MNES SIGNIFICANT IMPACT ASSESSMENTS

Table 9-1. Significant Impact Assessment for the Red Knot (*Calidris canutus*)

Endangered species Significant impact criteria. An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. The Red Knot is an infrequent visitor to the Darwin Harbour and whilst potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817, the species has not previously been recorded as occurring there. Sporadic records for the species occur at the Palmerston Sewerage Treatment Ponds 4 km to the north of the Project and at the East Arm Wharf 10 km to the north west. More frequent records occur between East Point and Lee Point-Buffalo Creek 18.5 km north west of the Project. The Project is not expected to impact any of these locations.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for this species. In line with the Conservation Advice for the Red Knot (TSSC 2016a) the Project has incorporated the requirements for the Red Knot into planning and proposed management to minimise the risk to any habitat suitable for this species, and thus not reduced the area of potentially suitable habitat this species may occupy in the Darwin Harbour.
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Whilst potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817, the species has not previously been recorded as occurring there. Surveys initiated by TNG in 2016, 2018 and 2019 did not record the Red Knot in these habitats, nor did two aerial and one boat survey reported by Lilleyman *et al* (2018, 2020b). This indicates there is no important habitat or key roosting and feeding sites within or near to the Project.
Disrupt the breeding cycle of a population	No	This species does not breed in Australia, the Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat for this species. Disturbance is expected to be reduced by the restriction of public entry to areas of potentially suitable habitat. Whilst not known to occur in close proximity to the project, there is potentially suitable habitat within and adjacent to Lot 1817.

		No habitat suitable for the Red Knot will be cleared. Risks associated with the Project that may impact the quality of potential habitats are expected to be limited to localised in scale and have a residual risk of Low to Medium. More frequent records of the Red Knot occur between East Point and Lee Point-Buffalo Creek 18.5 km north west of the Project. Habitats associated with the East Point to Lee Point-Buffalo Creek are not within the area of impact for the Project. No impacts originating from the project will cause habitat degradation for the Red Knot that would cause the species to decline. There is no important habitat or key roosting and feeding sites within or near to the Project.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	Conservation Advice for the Red knot (TSSC 2016) lists the habitat Conservation and Management Actions for the species. The Project is not in contravention of these actions as described below: The Project will not reduce the protection of roosting and feeding sites for threatened migratory shorebird species. In line with Conservation Advice the Project has incorporated the requirements for the threatened migratory shorebird species into planning and proposed management to minimise the risk to any habitat suitable for these species, and thus not reduced the area of potentially suitable habitat threatened migratory shorebird species may occupy in the Darwin Harbour. The Project has incorporated the requirements for threatened migratory shorebird species into the planning and proposed management by minimising the impacts to suitable habitat through selection of alternative processes. The Project has been allocated on the Site in a way that minimises the impact to threatened migratory shorebird species habitats. As proposed in the Migratory Shorebird Guideline (CoA 2017) a vegetation buffer has been allocated between the Project and the suitable habitats. Where this buffer is currently in a degraded condition the Project will rehabilitate to a standard that will increase the buffering capacity from Project impacts. The Project will reduce current disturbance to the Site where domestic dogs, cars and motorbikes have unrestricted access and an existing threat of introduced species and fire are present.

Table 9-2. Significant Impact Assessment for the Curlew Sandpiper (*Calidris ferruginea*)

Critically endangered species Significant impact criteria. An action is likely to have a significant impact on a critically endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. The Curlew Sandpiper is a frequent visitor to the Darwin Harbour and potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817. The NT Fauna Atlas includes 85 records within the Darwin Harbour, with the closest record being in the Elizabeth River within 1 km of Lot 1817. The species is frequently recorded at the Palmerston Sewage Treatment Ponds, 4 km north of Lot 1817. The species was not recorded in the Project area during avifauna surveys initiated by TNG in 2016, 2018 and 2019. Lilleyman *et al*. (2018) did not record the species but it is known to occur in low numbers at the East Arm Wharf 10 km to the north west (Lilleyman *et al*., 2020). The Project is not expected to impact any of these locations.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for this species. In line with the Conservation Advice for the Curlew Sandpiper (DoE 2015a) the Project has incorporated the requirements for the Curlew Sandpiper into planning and proposed management to minimise the risk to any habitat suitable for this species, and thus not reduced the area of potentially suitable habitat this species may occupy in the Darwin Harbour Proper.
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Whilst potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817, the species has only infrequently been recorded as occurring there. Surveys initiated by TNG in 2016, 2018 and 2019 did not record the Curlew Sandpiper in these habitats, nor did two aerial and one boat survey reported by Lilleyman *et al*. (2018, 2020b). This indicates there is no important habitat or key roosting and feeding sites within or near to the Project.
Disrupt the breeding cycle of a population	No	This species does not breed in Australia, the Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat for this species. Disturbance is expected to be reduced by the restriction of public entry to areas of potentially suitable habitat. Whilst not known to frequently occur in close proximity to the project, there is potentially suitable habitat within and adjacent to Lot 1817. No habitat suitable for the Curlew Sandpiper will be cleared. Risks associated with the Project that may impact the quality of potential habitats have a residual risk of Low to medium.

		No impacts originating from the project will cause habitat degradation for the Curlew Sandpiper that would cause the species 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	No	As recommended in DoE (2015a) TNG will manage invasive species in potentially suitable Curlew Sandpiper habitat by reduced access, monitoring and control actions where necessary. The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	Conservation Advice for the Curlew Sandpiper (DoE 2015) lists the habitat Conservation and Management Actions for the species. The Project is not in contravention of these actions as described below. The Project will not reduce the protection of roosting and feeding sites for threatened migratory shorebird species. In line with Conservation Advice the Project has incorporated the requirements for the threatened migratory shorebird species into planning and proposed management to minimise the risk to any habitat suitable for these species, and thus not reduced the area of potentially suitable habitat threatened migratory shorebird species may occupy in the Darwin Harbour. The Project has incorporated the requirements for threatened migratory shorebird species into the planning and proposed management by minimising the impacts to suitable habitat through selection of alternative processes. The Project has been allocated on the Site in a way that minimises the impact to threatened migratory shorebird species habitats. As proposed in the Migratory Shorebird Guideline (CoA 2017) a vegetation buffer has been allocated between the Project and the suitable habitats. Where this buffer is currently in a degraded condition the Project will rehabilitate to a standard that will increase the buffering capacity from Project impacts. The Project will reduce current disturbance to the Site where domestic dogs, cars and motorbikes have unrestricted access and an existing threat of introduced species and fire are present.

Table 9-3. Significant Impact Assessment for the Great Knot (*Calidris tenuirostris*)

Critically endangered species Significant impact criteria. An action is likely to have a significant impact on a critically endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. The Great Knot is a frequent visitor to the Darwin Harbour and potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817. The NT Fauna Atlas includes 75 records within the Darwin Harbour, the closest record being at the Palmerston Sewage

		Treatment Ponds, 4 km north of Lot 1817. The species is a frequent user of the East Arm Wharf where a maximum of 124 birds have been counted in one year over the 2013-2018 period, with the highest monthly counts occurring in February and September (Lilleyman & Garnett, 2019). The Project will not impact these locations.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for this species
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Whilst potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817, the species has only infrequently been recorded as occurring there. Surveys initiated by TNG in 2016, 2018 and 2019 did not record the Great Knot in these habitats, nor did two aerial and one boat survey reported by Lilleyman *et al* (2018, 2020b).
Disrupt the breeding cycle of a population	No	This species does not breed in Australia, the Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat for this species. Whilst not known to frequently occur in close proximity to the project, there is potentially suitable habitat within and adjacent to Lot 1817. No habitat suitable for the Great Knot will be cleared. Risks associated with the Project that may impact the quality of potential habitats have a residual risk of Low to medium. No impacts originating from the project will cause habitat degradation for the Great Knot that would cause the species 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	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The Project will not reduce suitable habitat.

Table 9-4. Significant Impact Assessment for the Greater Sand Plover (*Charadrius leschenaultii*)

Vulnerable species Significant impact criteria. An action is likely to have a significant impact on a Vulnerable 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	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. The Greater Sand Plover is a frequent visitor to the Darwin Harbour and potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817. This species has been recorded from the Elizabeth River adjacent to the Project (three records) in 2016, but not in 2018 or 2019.

		The NT Fauna Atlas includes 174 records within the Darwin Harbour, with the closest record being at the Elizabeth River adjacent to Lot 1817. The Greater Sand Plover is a frequent user of the East Arm Wharf, where a maximum of 560 birds have been counted in one month over the 2013 to 2018 period. The highest monthly counts occur in January to February and September to November (Lilleyman & Garnett, 2019). Darwin Harbour is a Nationally significant aggregation (and thus an important population) of this species with the East Arm Wharf of particular significance as roosting habitat during spring high tides. The Project will not impact the East Arm Wharf or reduce the available habitat in the Darwin Harbour. The Project will not impact the nationally significant aggregation.
Reduce the area of occupancy of an important population	No	The Project will not reduce the area of occupancy for this species. In line with the Conservation Advice for the Greater Sand Plover (TSSC 2016c) the Project has incorporated the requirements for the Greater Sand Plover into planning and proposed management to minimise the risk to any habitat suitable for this species, and thus not reduced the area of potentially suitable habitat this species may occupy in the Darwin Harbour Proper.
Fragment an existing important population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Suitable roosting habitat occurs in the saltpan within Lot 1817 and suitable foraging habitat occurs in the intertidal mudflats adjacent to Lot 1817. Whilst infrequently recorded in these habitats, it is likely the species uses them at some times. No habitat suitable for the Greater Sand Plover will be cleared. Risks associated with the Project that may impact the quality of potential habitats are of limited to localised scale and will not impact significant aggregation habitats for this species.
Disrupt the breeding cycle of an important population	No	This species does not breed in Australia, the Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat for this species. Suitable habitat within and adjacent to Lot 1817 is likely to be occasionally used by Greater Sand Plover. No habitat suitable for the Greater Sand Plover will be cleared. Disturbance is expected to be reduced by the restriction of public entry to areas of potentially suitable habitat. Risks associated with the Project that may impact the quality of potential habitats have a residual risk of Low to medium. No impacts originating from the project will cause habitat degradation for the Greater Sand Plover that would cause the species 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	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Monitoring of introduced predators in habitats such as the saltpan in Lot 1817 will improve the understanding of how significant the threat is and if introduced predators are found to be impacting threatened shorebird species control measures will be implemented in consultation with key stakeholders such as the Northern Territory

		Department of Natural Resources and Environment Flora and Fauna Branch. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	Conservation Advice for the Greater Sand Plover (TSSC, 2016) lists the habitat Conservation and Management Actions for the species. The Project is not in contravention of these actions as described below. The Project will not reduce the protection of roosting and feeding sites for threatened migratory shorebird species. In line with Conservation Advice the Project has incorporated the requirements for the threatened migratory shorebird species into planning and proposed management to minimise the risk to any habitat suitable for these species, and thus not reduced the area of potentially suitable habitat threatened migratory shorebird species may occupy in the Darwin Harbour. The Project has incorporated the requirements for threatened migratory shorebird species into the planning and proposed management by minimising the impacts to suitable habitat through selection of alternative processes. The Project has been allocated on the Site in a way that minimises the impact to threatened migratory shorebird species habitats. As proposed in the Migratory Shorebird Guideline (CoA 2017) a vegetation buffer has been allocated between the Project and the suitable habitats. Where this buffer is currently in a degraded condition the Project will rehabilitate to a standard that will increase the buffering capacity from Project impacts. The Project will reduce current disturbance to the Site where domestic dogs, cars and motorbikes have unrestricted access and an existing threat of introduced species and fire are present.

Table 9-5. Significant Impact Assessment for the Lesser Sand Plover (*Charadrius mongolus*)

Endangered species Significant impact criteria. An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. The Lesser Sand Plover is a frequent visitor to the Darwin Harbour and potentially suitable roosting habitat exists in the saltpan within Lot 1817 and potential foraging habitat occurs in the intertidal mudflats in Elizabeth River adjacent to Lot 1817. This species is considered highly likely to occur in the Elizabeth River adjacent to the Project. The NT Fauna Atlas includes 88 records within the Darwin Harbour, the closest record being at the Elizabeth River adjacent to Lot 1817. The species is a frequent user of the East Arm Wharf, where a maximum of 260 birds were counted in one year in 2013. Between 2014 and 2018, numbers declined below 50 per year (Lilleyman & Garnett, 2019). Over the 9 years of monthly bird counts at the East Arm Wharf the number of Lesser Sand Plover show a significant decline by 40%

		(Lilleyman *et al* 2020a). The highest monthly counts occur in February and September (Lilleyman & Garnett, 2019). Darwin Harbour is a Nationally significant aggregation of this species with the East Arm Wharf of particular significance as roosting habitat during spring high tides. The Project will not impact the East Arm Wharf or the Nationally Significant Aggregation.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for this species. In line with the Conservation Advice for the Lesser Sand Plover (TSSC 2016d) the Project has incorporated the requirements for the Lesser Sand Plover into planning and proposed management to minimise the risk to any habitat suitable for this species, and thus not reduced the area of potentially suitable habitat this species may occupy in the Darwin Harbour.
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. The species was not recorded in the habitats adjacent to the Project area in the field surveys initiated by TNG in 2016, 2018 and 2019, nor in the aerial and boat surveys conducted by Lilleyman et al (2018, 2020b). Suitable roosting habitat occurs in the saltpan within Lot 1817 and suitable foraging habitat occurs in the intertidal mudflats adjacent to Lot 1817. Whilst infrequently recorded in these habitats, it is likely the species uses them at some times. No habitat suitable for the Lesser Sand Plover will be cleared. Risks associated with the Project that may impact the quality of habitat are limited to localised in scale and will not affect habitats where significant aggregations occur.
Disrupt the breeding cycle of a population	No	This species does not breed in Australia, the Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat for this species. Suitable habitat within and adjacent to Lot 1817 is likely to be occasionally used by Lesser Sand Plover. No habitat suitable for the Lesser Sand Plover will be cleared. Disturbance is expected to be reduced by the restriction of public entry to areas of potentially suitable habitat. Risks associated with the Project that may impact the quality of potential habitats have a residual risk of low to medium. No impacts originating from the project will cause habitat degradation for the Lesser Sand Plover that would cause the species 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	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	Conservation Advice for the Lesser Sand Plover (TSSC, 2016) lists the habitat Conservation and Management Actions for the

		species. The Project is not in contravention of these actions as described below. The Project will not reduce the protection of roosting and feeding sites for threatened migratory shorebird species. In line with Conservation Advice the Project has incorporated the requirements for the threatened migratory shorebird species into planning and proposed management to minimise the risk to any habitat suitable for these species, and thus not reduced the area of potentially suitable habitat threatened migratory shorebird species may occupy in the Darwin Harbour. The Project has incorporated the requirements for threatened migratory shorebird species into the planning and proposed management by minimising the impacts to suitable habitat through selection of alternative processes. The Project has been allocated on the Site in a way that minimises the impact to threatened migratory shorebird species habitats. As proposed in the Migratory Shorebird Guideline (CoA 2017) a vegetation buffer has been allocated between the Project and the suitable habitats. Where this buffer is currently in a degraded condition the Project will rehabilitate to a standard that will increase the buffering capacity from Project impacts. The Project will reduce current disturbance to the Site where domestic dogs, cars and motorbikes have unrestricted access and an existing threat of introduced species and fire are present.

Table 9-6. Significant Impact Assessment for the Far Eastern Curlew (*Numenius madagascariensis*)

Critically endangered species Significant impact criteria. An action is likely to have a significant impact on a critically endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not lead to a long-term decrease in the size of the Far Eastern Curlew population. The intertidal mudflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat for the Far Eastern Curlew, the saltpan area within Lot 1817 and the mangrove habitat adjacent is suitable roosting habitat for this species and the Far Eastern Curlew has been frequently recorded using these habitats over a number of years. Lilleyman et al. (2018, 2020b) recorded the distribution of the Far Eastern Curlew in the Darwin Harbour at low tide and at high tide during a spring tide in 2017 and 2020. These studies found Far Eastern Curlew prefers foraging habitats close to suitable saltpan/saltmarsh roosting habitat, and roosting habitat close to foraging habitat. A tracking study found the species to maintain small home ranges (Lilleyman & Garnett, 2019). At the peak of the tide, when the saltpan/saltmarsh was inundated, birds moved to two key locations – a large saltmarsh near the Conoco Phillips Project site on the eastward end of Middle Arm Peninsula and a dredging pond in East Arm Wharf. According to Lilleyman *et al*. (2018), the roosting habitat at East Arm Wharf is now particularly important: over 80 % of the local Darwin Harbour population, or close to 1 % of the global population, of Far Eastern Curlew roost there during the highest tides. Lilleyman *et al* (2020a) report an increase in the number of Far Eastern Curlew at the East Arm

		Wharf over the 9 year period of records. The Darwin Harbour Proper is a nationally significant aggregation of this species and approaching an internationally significant aggregation, with the East Arm Wharf noted as a particularly important roosting habitat during spring high tides. Lilleyman *et al* (2018) speculate that it is the increased availability in roosting habitat that may be driving the increase in Far Eastern Curlew numbers in the Darwin Harbour. The maximum number of Far Eastern Curlew recorded using the habitats within or adjacent to Lot 1817 in a single survey is 4 birds, with the median being 1 bird. No Far Eastern Curlew will be killed as a result of the Project. No habitat is to be cleared during the Project. The area between the habitat and the Project has been allocated a vegetation buffer. Disturbances associated with the project will predominantly occur 200 m from the roosting habitat within and adjacent to Lot 1817 and 400 m from the foraging habitat in the Elizabeth River. Disturbances such as domestic dog interactions are expected to decrease as a result of the Project restricting access to the site which has historically been unregulated and frequented by people with dogs and motorbikes. Introduced predators (cats and pigs) were recorded during the biological surveys of the site. The Project has committed to monitoring introduced fauna and implementing control measures where needed, which will reduce the threat from the present situation. Some expected project impacts may pose a risk to the quality of the habitats for Far Eastern Curlew within and adjacent to Lot 1817. These expected impacts are noise, light, altered hydrology, contamintion and human disturbance. The impacts are limited or localised and post-mitigation, the residual risks have been determined to be Low and are not expected to lead to a long term decrease in the size of the population of Far Eastern Curlew in the habitats within and adjacent to the Project, or at the sites of aggregation in East Arm Wharf or in Darwin Harbour.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for the Far Eastern Curlew. In line with the Conservation Advice for the Far Eastern Curlew (Doe 2015b) the Project has incorporated the requirements for the species into planning and proposed management to minimise the risk to any habitat suitable for this species, and thus not reduced the area of potentially suitable habitat this species may occupy in the Darwin Harbour Proper. No Far Eastern Curlew habitat is to be cleared during the Project. Some expected project impacts may pose a risk to the quality of the habitats for Far Eastern Curlew within and adjacent to Lot 1817. These expected impacts are noise, light, altered hydrology, contamination and human disturbance. These impacts will be limited or localised in scale and post-mitigation, the residual risks have been determined to be Low and are not expected to lead to a long term decrease in the quality of the habitats within and adjacent to the Project, at the East Arm Wharf or in Darwin Harbour.
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of the Far Eastern Curlew. The positioning of the Project is on the outer edge of the Harbour and is on the outer edge of the known distribution of the

		Far Eastern Curlew within the Darwin Harbour (Lilleyman *et al* 2018, 2020b). The mangrove and intertidal mudflats in the area are large and have a high level of connectivity. Loss of the mangrove and intertidal mudflats in the vicinity of Lot 1817 as a consequence of the Project would not increase the distance required to be travelled between these habitat types. Saltpan roosting areas are less frequent in Darwin Harbour and are likely a limited resource (Lilleyman *et al*. 2018). Loss of the saltpan within Lot 1817 as a consequence of the Project would not cause fragmentation as there are similar quality habitats nearby, but it would likely displace birds into surrounding mangrove habitat for roosting.
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. No habitat suitable for the Far Eastern Curlew will be cleared as a result of the Project. Some expected project impacts may pose a risk to the quality of the habitats for Far Eastern Curlew within and adjacent to Lot 1817. These expected impacts are noise, light, altered hydrology, contamination and human disturbance. Post mitigation, the residual risks have been determined to be Low and are not expected to impact the populations of Far Eastern Curlew in the habitats within and adjacent to the Project, at the East Arm Wharf or in Darwin Harbour.
Disrupt the breeding cycle of a population	No	This species does not breed in Australia, the Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat for this species. Some expected project impacts may pose a risk to the quality of the habitats for Far Eastern Curlew within and adjacent to Lot 1817. These expected impacts are noise, light, altered hydrology, contamination and human disturbance. The scale of the impacts is limited to localised and post mitigation, the residual risks have been determined to be Low and will not decrease the quality of habitats within and adjacent to the Project, at the East Arm Wharf or in Darwin Harbour Proper. If the Project impacts were to lead to habitat degradation it would at worst lead to the loss of the saltpan roosting habitat within proximity of the Project due to loss of quality which would be the loss of 4.69 ha, or 0.58%* of the potential saltpan roosting habitat available in Darwin Harbour Proper. Loss of the potentially suitable intertidal mudflat foraging habitat within proximity of the Project due to loss of quality would be the loss of 46.14 ha, or 0.93%† of the potential intertidal mudflat foraging habitat available in Darwin Harbour Proper. Loss of the Mangrove foraging and roosting habitat adjacent to Lot 1817 would be the loss of 274.31 ha, or 1.42%* of the potential mangrove habitat available in the Darwin Harbour Proper. The presence of the project is expected to reduce the risk of disturbance in line with CoA (2015) and DoE (2015b) by prohibiting vehicle access, horse riding and dogs, and implementing restricted access to all people. The Project layout has been allocated in recognition of Far Eastern Curlew habitat and the noisier processes have been allocated to the southern node, at the furthest distance from the saltpan habitat possible within Lot 1817.

		Noisy activity in proximity to the Far Eastern Curlew saltpan roosting habitat is limited to the proposed rehabilitation of land outside of the Development Envelope. This is short term. A vegetation buffer has been allocated between the Project and roosting habitat approximately 200 m wide. An additional 200 m of vegetation is between the Project and the feeding habitat.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Surveys initiated by TNG at Lot 1817 found introduced fauna to be present. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site and reduce the disturbance to Far Eastern Curlew.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	Conservation Advice for the Eastern Curlew (DoE 2015) lists the habitat Conservation and Management Actions for the species. The Project is not in contravention of these actions as described below. The Project will not reduce the protection of roosting and feeding sites for threatened migratory shorebird species. In line with Conservation Advice the Project has incorporated the requirements for the threatened migratory shorebird species into planning and proposed management to minimise the risk to any habitat suitable for these species, and thus not reduced the area of potentially suitable habitat threatened migratory shorebird species may occupy in the Darwin Harbour. The Project has incorporated the requirements for threatened migratory shorebird species into the planning and proposed management by minimising the impacts to suitable habitat through selection of alternative processes. The Project has been allocated on the Site in a way that minimises the impact to threatened migratory shorebird species habitats. As proposed in the Migratory Shorebird Guideline (CoA 2017) a vegetation buffer has been allocated between the Project and the suitable habitats. Where this buffer is currently in a degraded condition the Project will rehabilitate to a standard that will increase the buffering capacity from Project impacts. The Project will reduce current disturbance to the Site where domestic dogs, cars and motorbikes have unrestricted access and an existing threat of introduced species and fire are present.

* Saltpan and Mangrove habitat area calculated from the Darwin 1:100,000 Mangrove mapping dataset (NTG 2019).

† Intertidal mudflat area calculated from the National Intertidal Digital Elevation Model (Bishop-Taylor *et al*., 2019)

Table 9-7. Significant Impact Assessment for the Painted Snipe (*Rostratula australis*)

Endangered species Significant impact criteria. An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. There are no records of Painted Snipe within 10 km of the Project.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for this species
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project will not adversely affect habitat critical to the survival of this species. No habitat for the Painted Snipe occurs within the Project area.
Disrupt the breeding cycle of a population	No	No suitable breeding habitat is present in the Project area and no Painted Snipe have been recorded within 10 km of the Project. The Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	No habitat for the Painted Snipe occurs within the Project area.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	No suitable breeding habitat is present in the Project area and no Painted Snipe have been recorded within 10 km of the Project.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The Project will not interfere with the recovery of this species.

Table 9-8. Significant Impact Assessment for the Partridge Pigeon (eastern) (*Geophaps smithii smithii*)

Vulnerable species Significant impact criteria. An action is likely to have a significant impact on a Vulnerable 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	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. There are no records of Partridge Pigeon within 10 km of the Project.
Reduce the area of occupancy of an important population	No	The Project will not reduce the area of occupancy for this species
Fragment an existing important population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project will not adversely affect habitat critical to the survival of this species. No known habitat for the Partridge Pigeon occurs within the Project area.
Disrupt the breeding cycle of a population	No	No suitable breeding habitat is present in the Project area and no Partridge Pigeon have been recorded within 10 km of the Project. The Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	Potentially suitable habitat occurs in the open Woodland vegetation however Partridge Pidgeon are not known to occupy this vegetation within Lot 1817. On a regional level the Open Woodland vegetation proposed to be cleared as a result

		of the Project constitutes 0.001%* of similar habitat type and quality in the Darwin area. Loss of the Open Woodland vegetation in the Development Envelope will not lead to the decline of the species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	No Partridge Pigeon have been recorded within 10 km of the Project. Invasive species will not impact the Partridge Pigeon in relation to the Project. TNG has committed to monitor invasive species and initiate control actions if invasive species are recorded to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The Project will not interfere with the recovery of this species.

*Figures used to calculate the regional extent of the vegetation type were sourced from the digitization of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000)

Table 9-9. Significant Impact Assessment for the Red Goshawk (*Erythrotriorchis radiatus*)

Vulnerable species Significant impact criteria. An action is likely to have a significant impact on a Vulnerable 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	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. There are no records of Red Goshawk within 10 km of the Project.
Reduce the area of occupancy of an important population	No	The Project will not reduce the area of occupancy for this species
Fragment an existing important population into two or more populations	No	The Project will not fragment the habitat of this species
Adversely affect habitat critical to the survival of a species	No	The project will not adversely affect habitat critical to the survival of this species. No known habitat for the Red Goshawk occurs within the Project area.
Disrupt the breeding cycle of a population	No	No suitable breeding habitat is present in the Project area and no Red Goshawk have been recorded within 10 km of the Project. The Project will not disrupt the breeding cycle
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	Potentially suitable habitat occurs in the open Woodland vegetation however Red Goshawk are not known to occupy this vegetation within Lot 1817. On a regional level the Open Woodland vegetation proposed to be cleared as a result of the Project constitutes 0.001% of similar habitat type and quality in the Darwin area. Loss of the Open Woodland vegetation in the Development Envelope will not lead to the decline of the species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	No Red Goshawk have been recorded within 10 km of the Project. Invasive species will not impact the Red Goshawk in relation to the Project. TNG has committed to monitor invasive species and initiate control actions if invasive species are found to be increasing.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.

Interfere with the recovery of the species.	No	The Project will not interfere with the recovery of this species.

*Figures used to calculate the regional extent of the vegetation type were sourced from the digitization of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000)

Table 9-10. Significant Impact Assessment for the Fork-tailed Swift (*Apus pacificus*)

Migratory species Significant impact criteria. 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	No	There is no important habitat for this species in Darwin Harbour. The species is gregarious and often feeding in flocks of up to 1000. Only one individual was recorded on one occasion at high altitude over Lot 1817. The Fork-tailed Swift does not breed in Australia so has no breeding habitat and rarely comes to land so there is no critical habitat in the vicinity of the Project area for breeding or roosting. The Fork-tailed Swift visits all states and territories in Australia so it is not at the end of its range in the Darwin area.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	Suitable habitat exists over Lot 1817 and adjacent water and across the coastal interface of the Darwin Harbour. The Fork-tailed Swift is almost exclusively aerial and forages aerially on insects above open areas or over water, and occasionally among tree-tops in open forest probably roosts aerially but has occasionally been observed to land. It is known to sometimes loaf in the air by allowing strong winds to support it. The species is thus not exposed to predation by cats, dogs and foxes.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There is no ecologically significant proportion of the Fork-tailed Swift near to the Project or in the Darwin Harbour.

Table 9-11. Significant Impact Assessment for the Common Sandpiper

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Common Sandpiper is 190 birds. Surveys in the Project area recorded 116 birds over 3 years of survey with multiple surveys per year. The maximum number of birds from a single survey is 15. The Darwin Harbour Proper does not host a nationally significant aggregation of Common Sandpiper (Lilleyman *et al*. 2019, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area so there is no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project.

		The Common Sandpiper Australian distribution is the coastlines of Australia, and inland. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for the 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There is no ecologically significant population of the Common Sandpiper in the Darwin Harbour Proper.

Table 9-12. Significant Impact Assessment for the Ruddy Turnstone (*Arenaria interpres*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Ruddy Turnstone is 30 birds. Surveys in the Project area recorded one bird over three years of survey with multiple surveys per year. The maximum number of birds from a single survey is one, with all other surveys recording no Ruddy Turnstone. The Darwin Harbour Proper does not host a nationally significant aggregation of Ruddy Turnstone (Lilleyman *et al*. 2019, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area so there is no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Ruddy Turnstone is widespread on the coastlines of Australia, and infrequently inland. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Ruddy Turnstone in the Darwin Harbour Proper.

Table 9-13. Significant Impact Assessment for the Sharp-tailed Sandpiper (*Calidris acuminata*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Sharp-tailed Sandpiper is 85 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Sharp-tailed Sandpiper (Lilleyman *et al*. 2019, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area so there is no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Sharp-tailed Sandpiper is widespread in Australia, but most common in the southeast. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Sharp-tailed Sandpiper in the Darwin Harbour Proper.

Table 9-14. Significant Impact Assessment for the Sanderling (*Calidris alba*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Sanderling is 30 birds. One individual was recorded in surveys in the Project area across 3 years with multiple surveys per year with the remaining surveys recording none. The Darwin Harbour Proper does not host a nationally significant aggregation of Sanderling (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Sanderling is widespread in the coastal areas of Australia. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Sanderling in the Darwin Harbour Proper.

Table 9-15. Significant Impact Assessment for the Red-necked Stint (*Calidris ruficollis*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Red-necked Stint is 475 birds. One individual was recorded in surveys in the Project area across 3 years with multiple surveys per year with the remaining surveys recording none. The Darwin Harbour Proper does not host a nationally significant aggregation of Red-necked Stint (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Red-necked Stint visits most of the Australian coastline, with highest densities in Victoria and Tasmania. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Red-necked Stint in the Darwin Harbour Proper.

Table 9-16. Significant Impact Assessment for the Long-toed Stint (*Calidris subminuta*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Long-toed Stint is 230 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Long-toed Stint (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Long-toed Stint is sparsely distributed along coast, especially in the east of Australia. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this species.
Result in an invasive species that is harmful to the migratory species becoming	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to increasing. Active management of feral

established in an area of important habitat for the migratory species		predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Long-toed Stint in the Darwin Harbour Proper.

Table 9-17. Significant Impact Assessment for the Little Ringed Plover (*Charadrius dubius*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Little Ringed Plover is 150 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Little Ringed Plover (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Little Ringed Plover is a regular, but uncommon visitor to Australia (CoA, 2015). In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Little Ringed Plover in the Darwin Harbour Proper.

Table 9-18. Significant Impact Assessment for the Oriental Plover (*Charadrius veredus*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Oriental Plover is 230 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Oriental Plover (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Oriental Plover occurs in coastal and inland areas of Australia. Most records are from the northwest coast, with scattered records from other areas, such as

		the Top End, NT. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Oriental Plover in the Darwin Harbour Proper.

Table 9-19. Significant Impact Assessment for the Asian Dowitcher (*Limnodromus semipalmatus*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Asian Dowitcher is 230 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Asian Dowitcher (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Asian Dowitcher is a regular, but uncommon visitor to northwest Australia, especially between Port Hedland and Broome. In the NT, it is found in Darwin and Arnhem Land. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Asian Dowitcher in the Darwin Harbour Proper.

Table 9-20. Significant Impact Assessment for the Black-tailed Godwit (*Limosa limosa*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Black-tailed Godwit is 160 birds. Six individuals were recorded in one survey in the Project area. Surveys were conducted across 3 years with multiple surveys per year and all other surveys recorded no individuals.

		The Darwin Harbour Proper does not host a nationally significant aggregation of Black-tailed Godwit (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Black-tailed Godwit is found around coastal areas of Australia, especially between Darwin and Weipa. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Black-tailed Godwit in the Darwin Harbour Proper.

Table 9-21. Significant Impact Assessment for the Little Curlew (*Numenius minutus*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Little Curlew is 110 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Little Curlew (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Little Curlew is found predominantly in northern Australia. In the NT, it is widespread in the Top End, from Keep River NP, east to Gove Peninsula and Groote Eylandt, and south to Kidman Springs. It has also been recorded in Alice Springs and the Tanami Desert. In Darwin Harbour the species is not at the end of its range. The Project will not impact any important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Little Curlew in the Darwin Harbour Proper.

Table 9-22. Significant Impact Assessment for the Whimbrel (*Numenius phaeopus*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Whimbrel is 65 birds. Surveys in the Project area across 3 years with multiple surveys per year recorded this species a total of 34 times. The maximum count in a single survey was 5 birds. The Darwin Harbour Proper hosts a nationally significant aggregation of Whimbrel (Lilleyman *et al*. 2018, 2020a,b). The East Arm Wharf has recorded 116 birds, 77 birds have been counted in a single survey of the Darwin Harbour Middle Arm and 344 birds counted in a whole of Harbour survey. Suitable general, foraging, and roosting habitat exists in the mudflats and mangroves adjacent to the Project area. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (August – April), while immature individuals may remain at the site throughout the austral winter (*i.e*. year-round until they sexually mature). No habitat suitable for the Whimbrel will be cleared. impacts that may affect the quality of Whimbrel habitat are limited to localised and residual risks are Low. If the Project impacts were to lead to habitat degradation it would at worst lead to the loss of the saltpan roosting habitat within proximity of the Project due to loss of quality which would be the loss of 4.69 ha, or 0.58%* of the potential saltpan roosting habitat available in Darwin Harbour Proper. Loss of the intertidal mudflat foraging habitat within proximity of the Project due to loss of quality would be the loss of 46.14 ha, or 0.93%† of the potential intertidal mudflat foraging habitat available in Darwin Harbour Proper. Loss of the Mangrove foraging and roosting habitat adjacent to Lot 1817 would be the loss of 274.31 ha, or 1.42%* of the potential mangrove habitat available in the Darwin Harbour Proper. The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. Project impacts are limited to local in scale and not expected to affect the significant aggregation at the East Arm Wharf or Middle Arm. The Whimbrel is found around the coast of Australia, predominantly in the north, with scattered inland records. In the NT, it is found around the coast of the Top End, and sometimes follows rivers inland. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al*. (2020a) records a significant increase in the size of the Whimbrel population at the East Arm Wharf over a 9 year period to 2018.

Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	The Middle Arm of Darwin Harbour hosts a nationally significant aggregation of Whimbrel. Suitable general, foraging, and roosting habitat exists in the mudflats and mangroves fringing Middle Arm including adjacent to the Project area. A maximum of 5 birds has been recorded in any single survey adjacent to the Project area. The Project impacts are limited to local in scale and will not cause a significant proportion of the population at Middle Arm to be disturbed.
* Saltpan and mangrove habitat area calculated from the Darwin 1:100,000 Mangrove mapping dataset (NTG 2019). † Intertidal mudflat area calculated from the National Intertidal Digital Elevation Model (Bishop-Taylor *et al*., 2019)		

Table 9-23. Significant Impact Assessment for the Pacific Golden Plover (*Pluvialis fulva*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Pacific Golden Plover is 120 birds. Surveys in the Project area across 3 years with multiple surveys per year recorded 10 individuals in 2016 and 5 individuals in 2019, with a maximum single count of 5. The Darwin Harbour Proper does not host a nationally significant aggregation of Pacific Golden Plover (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Pacific Golden Plover is widespread in coastal regions of Australia, with scattered records inland. It is most common along the eastern coast. In the NT, it is regularly recorded in coastal areas of the Top End. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al*. (2020a) does not record a significant change in the size of the population at the East Arm Wharf over a 9 year period to 2018. For these reasons Lot 1817 is not Important Habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Pacific Golden Plover in the Darwin Harbour Proper.

Table 9-24. Significant Impact Assessment for the Grey Plover (*Pluvialis squatarola*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Grey Plover is 80 birds. Surveys in the Project area in 2016 recorded 30 birds of this species. Repeated survey in 2018 and 2019 did not record this species. The SPRAT database reports that Greater Darwin Area hosts a nationally significant aggregation of Grey Plover. This is determined from the work of Chatto (2006) and includes the beaches north of Darwin. Resurvey of the area in 2010 and 2011 had counts below the threshold and counts by Lilleyman *et al*. (2018, 2020a,b) do not record this species in significant numbers in Darwin Harbour Proper. The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Grey Plover is found predominantly in northern Australia. In the NT, it is widespread in the Top End, from Keep River NP, east to Gove Peninsula and Groote Eylandt, and south to Kidman Springs. It has also been recorded in Alice Springs and the Tanami Desert. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al*. (2020a) records a significant decrease of 12% in the size of the Grey Plover population at the East Arm Wharf over a 9 year period to 2018. Chatto (2006, 2012) reports a decrease in the records of this species in the Greater Darwin Area. The Darwin Harbour Proper is thus considered Important Habitat for the Grey Plover due to the significant reduction in records. The habitat in or adjacent to Lot 1817 had visitation by the Grey Plover in 2016 but the species was not recorded in 2018 and 2019 possibly due to its overall decline in the region. Suitable general and foraging habitat exists in the mudflats adjacent to the Project area. The Grey Plovers preferred roosting habitat is not present in or adjacent to Lot 1817, but it could potentially be using other non-preferred habitats for roosting. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (August – May), while immature individuals may remain at the site throughout the austral winter (*i.e*. year-round until they sexually mature). No Grey Plover habitat will be cleared by the Project. impacts that may affect the quality of Grey Plover habitat are limited to localised and residual risks of are Low. If the Project impacts were to lead to habitat degradation it would at worst lead to the loss of the intertidal mudflat foraging habitat within proximity of the Project due to loss of quality which would be the loss of 46.14 ha, or 0.93%† of the potential intertidal mudflat foraging habitat available in Darwin Harbour Proper.

		There is a 400 m vegetation buffer between the habitat and the Project.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Grey Plover in the Darwin Harbour Proper.

† Intertidal mudflat area calculated from the National Intertidal Digital Elevation Model (Bishop-Taylor *et al*., 2019)

Table 9-25. Significant Impact Assessment for the Grey-tailed Tattler (*Tringa brevipes*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Grey-tailed tattler is 70 birds. Surveys in the Project area in 2016, 2018 and 2019 (with multiple surveys each of those years) recorded a total of 80 birds of this species. The maximum record in a single count was 15 birds. Counts by Lilleyman *et al*. (2020b) record a nationally significant aggregation of Grey-tailed Tattler on the Middle Arm Peninsula of Darwin Harbour in 2019 with 101 birds. The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Grey-tailed Tattler primarily occurs in the northern coastal regions of Australia. In the NT, it is widespread along coastal regions, from the border with WA to Melville Island, and east to Gove Peninsula. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al*. (2020a) records a decrease of 29% in the size of the Grey-tailed Tattler population at the East Arm Wharf over a 9 year period to 2018, however the change was not significant which indicates large fluctuations in annual visitation or use of particular habitat year to year. The Middle Arm Peninsula, Darwin Harbour is thus considered Important Habitat for the Grey Tailed Tattler due to the nationally significant aggregation recorded by Lilleyman *et al*. (2020b) Suitable general, foraging, and roosting habitat exists in the mudflats and mangroves adjacent to the Project area. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (August – April), while immature individuals may remain at the site throughout the austral winter (*i.e*. year-round until they sexually mature). No Grey-tailed Tattler habitat will be cleared by the Project. Impacts that may affect the quality of Grey-tailed Tattler habitat are limited to localised with residual risks of Low and are unlikely to impact on the significant aggregations of this species.

		If the Project impacts were to lead to habitat degradation it would at worst lead to the loss of the intertidal mudflat foraging habitat within proximity of the Project due to loss of quality which would be the loss of 46.14 ha, or 0.93%† of the potential intertidal mudflat foraging habitat available in Darwin Harbour Proper. Loss of the Mangrove foraging and roosting habitat adjacent to Lot 1817 would be the loss of 274.31 ha, or 1.42%* of the potential mangrove habitat available in the Darwin Harbour Proper.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	Counts by Lilleyman *et al*. (2020b) record a nationally significant aggregation of Grey-tailed Tattler on the Middle Arm Peninsula of Darwin Harbour in 2019 with 101 birds. The maximum number of birds recorded in the habitats adjacent to the Project area is 15 birds or 15% of the population. A nationally significant aggregation of Grey-tailed Tattler is 70 birds. In a worst case scenario if 15% of the population at Middle Arm were to be adversely impacted by the Project the remaining population would still qualify as a nationally significant aggregation based upon the Lilleyman (2020b) survey numbers. As the risk of bird death is Low, it is more likely Grey-tailed Tattler would use other suitable habitat nearby rather than be lost from the population if the Project caused habitat to be unsuitable.

* Saltpan and Mangrove habitat area calculated from the Darwin 1:100,000 Mangrove mapping dataset (NTG 2019).
† Intertidal mudflat area calculated from the National Intertidal Digital Elevation Model (Bishop-Taylor *et al*., 2019)

Table 9-26. Significant Impact Assessment for the Wood Sandpiper (*Tringa glareola*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Wood Sandpiper is 130 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Wood Sandpiper (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Wood Sandpiper occurs around Australia but is most common in northwest Australia. All areas of national importance are in WA. In the NT, there are scattered inland records from Keep River, east to Victoria River and Ngukurr, and south to Alice Springs, with coastal records from the Darwin area. In Darwin Harbour the species is not at the end of its range.

		Whilst not treated individually for this species, Chatto (2012) and Lilleyman *et al* (2020a) report an overall increase in migratory shorebird numbers in Darwin and the NT.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Wood Sandpiper in the Darwin Harbour Proper.

Table 9-27. Significant Impact Assessment for the Common Greenshank (*Tringa nebularia*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Common Greenshank is 110 birds. Surveys in the Project area across 3 years with multiple surveys per year recorded a total of 19 records for this species. The maximum individual count was 3 birds. The Darwin Harbour Proper does not host a nationally significant aggregation of Common Greenshank (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Common Greenshank is known to have the widest distribution of any migratory shorebird in Australia. In the NT, it is sparsely scattered throughout most of the state. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al* (2020a) reported a significant increase in Common Greenshank numbers over a 9 year period to 2018. The Darwin Harbour is not considered important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Common Greenshank in the Darwin Harbour Proper.

Table 9-28. Significant Impact Assessment for the Marsh Sandpiper (*Tringa stagnatilis*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Marsh Sandpiper is 130 birds. Surveys in the Project area across 3 years with multiple surveys per year did not record this species. The Darwin Harbour Proper does not host a nationally significant aggregation of Marsh Sandpiper (Lilleyman *et al*. 2018, 2020a,b). The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Marsh Sandpiper is found in coastal and inland wetlands across Australia. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al* (2020a) reported a significant increase in Marsh Sandpiper numbers over a 9 year period to 2018. The Darwin Harbour is not considered important habitat for this 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	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	There are no ecologically significant aggregations of Marsh Sandpiper in the Darwin Harbour Proper.

Table 9-29. Significant Impact Assessment for the Terek Sandpiper (*Xenus cinereus*)

Migratory species Significant impact criteria. 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	No	A nationally significant aggregation of Terek Sandpiper is 50 birds. Surveys in the Project area across 3 years with multiple surveys per year collected a total of 61 records this species. The maximum count for a single survey is 9 birds. The Middle Arm Peninsula of Darwin Harbour hosts a nationally significant aggregation of Terek Sandpiper (Lilleyman *et al*. 2020b) with a maximum count of 100 birds. The species does not breed in Australia so there is no breeding habitat in the Project area and no habitat that is of critical importance to the species at particular life-cycle stages associated with the Project. The Terek Sandpiper primarily occurs around the coast of Australia, with occasional records inland. It is more widespread in the north and east. In the NT, it occurs from Darwin, north to Melville Island, and east to the Gulf of Carpentaria. In Darwin Harbour the species is not at the end of its range. Lilleyman *et al* (2020a) reported no significant difference in Marsh Sandpiper numbers at the East Arm Wharf over a 9 year period to 2018. The Darwin Harbour is considered important habitat for this species due to the nationally significant aggregation recorded at Middle Arm. Suitable general, foraging, and roosting habitat exists in the mudflats, samphire, and mangroves adjacent to the Project

		area. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (August – April), while immature individuals may remain at the site throughout the austral winter (*i.e*. year-round until they sexually mature). No Terek Sandpiper habitat will be cleared by the Project. Impacts that may affect the quality of Terek Sandpiper habitat are limited to local in scale and residual risks is Low. If the Project impacts were to lead to habitat degradation it would at worst lead to the loss of the saltpan roosting habitat within proximity of the Project due to loss of quality which would be the loss of 4.69 ha, or 0.58%* of the potential saltpan roosting habitat available in Darwin Harbour Proper. Loss of the intertidal mudflat foraging habitat within proximity of the Project due to loss of quality would be the loss of 46.14 ha, or 0.93%† of the potential intertidal mudflat foraging habitat available in Darwin Harbour Proper. Loss of the Mangrove foraging and roosting habitat adjacent to Lot 1817 would be the loss of 274.31 ha, or 1.42%* of the potential mangrove habitat available in the Darwin Harbour Proper. There is a vegetation buffer allocated between the Project and the habitat.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	Counts by Lilleyman *et al*. (2020b) record a nationally significant aggregation of Terek Sandpiper on the Middle Arm Peninsula of Darwin Harbour in 2019 with 100 birds. The maximum number of birds recorded in the habitats adjacent to the Project area is 9 birds or 9% of the maximum recorded population. A nationally significant aggregation of Terek Sandpiper is 50 birds. In a worst case scenario if 9% of the population at Middle Arm were to be adversely impacted by the Project the remaining population would still qualify as a nationally significant aggregation based upon the Lilleyman (2020b) survey numbers. As the risk of bird death is Low, it is more likely Terek Sandpiper would use other suitable habitat nearby rather than be lost from the population if the Project caused habitat to be unsuitable.

* Saltpan habitat area calculated from the Darwin 1:100,000 Mangrove mapping dataset (NTG 2019).

† Intertidal mudflat area calculated from the National Intertidal Digital Elevation Model (Bishop-Taylor *et al*., 2019)

Table 9-30. Significant Impact Assessment for the Eastern Osprey (*Pandion cristatus*)

Migratory species Significant impact criteria. 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	No	Eastern Ospreys usually occur singly, occasionally in twos, or more rarely in family groups. Lack of aggregation means habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species is more

isolate an area of important habitat for a migratory species		difficult to define. The habitats available in Lot 1817 were surveyed across 3 years (2016, 2018 and 2019) with multiple surveys per year. One record of one Eastern Osprey was made over that period, with the bird flying at high altitude in foraging activity. No nesting was observed in Lot 1817. Nests are large and easily identified and it can be concluded that lack of nests means Eastern Osprey are not using the habitat in Lot 1817 for breeding. The breeding range of the Eastern Osprey extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in NSW; with a second isolated breeding population on the coast of South Australia, extending from Head of Bight east to Cape Spencer and Kangaroo Island. In the Darwin Harbour the Eastern Osprey is not at the limit of its range. Numbers appear to be stable in northern Australia (Dennis 2007a; Garnett 1993) Darwin Harbour is not considered important habitat for the Eastern Osprey.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	No	TNG has committed to monitor invasive species and initiate control actions if invasive species are considered to be increasing. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No	Lot 1817 does not support an ecologically significant proportion of the Eastern Osprey.

Table 9-31. Significant Impact Assessment for the Fawn Antechinus (*Antechinus bellus*).

Vulnerable species Significant impact criteria. An action is likely to have a significant impact on a Vulnerable 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	No	Across 3 systematic fauna surveys at Lot 1817 initiated by TNG Fawn Antechinus has not been recorded in Lot 1817. The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. Prior to vegetation clearing all fauna will be translocated from the demarcated clearing area, including searching of any tree hollows where the species may be denning.
Reduce the area of occupancy of an important population	No	The Project will not reduce the area of occupancy for this species, as it is not known to occur within Lot 1817.
Fragment an existing important population into two or more populations	No	The Project will not fragment the habitat of this species. The potentially suitable habitat for the Fawn Antechinus is widespread in the Darwin region (Section 3.3.1). Removal of potentially suitable habitat in Lot 1817 will not reduce the connectivity of the remaining suitable habitat in the Middle Arm area.
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Suitable habitat occurs in the Eucalypt Woodland habitat of Lot 1817, of which 92.5 ha is proposed to be cleared. No critical habitat for Fawn Antechinus is considered to

		occur in Lot 1817 as the Fawn Antechinus has not been recorded across 3 systematic fauna surveys. Risks associated with the Project that may impact the quality of remnant potential habitats have a residual risk of Low to Medium.
Disrupt the breeding cycle of an important population	No	As the Fawn Antechinus has not been recorded in Lot 1817 it is not expected that the Project will disrupt the breeding cycle.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The Project proposes to clear 92.5 ha of potentially suitable Eucalyptus Woodland habitat. Loss of the potentially suitable habitat will be a 0.01%* reduction of the total available habitat in the Darwin region. No impacts originating from the project will cause habitat degradation for the Fawn Antechinus that would cause the species 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	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Sightings of introduced predators in Lot 1817 will be recorded and if introduced predators are found to be increasing control measures will be implemented in consultation with key stakeholders such as the DEPWS Flora and Fauna Branch. The Project will remove 9.5 ha of breeding habitat for the Cane Toad, which is a threatening process for the Fawn Antechinus. Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The Project is not expected to interfere with the recovery of the species.

*Figures used to calculate the regional extent of the vegetation type were sourced from the digitization of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000)

Table 9-32. Significant Impact Assessment for the Northern Quoll (*Dasyurus hallucatus*)

Endangered species Significant impact criteria. An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project will not impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. There are no records of Northern Quoll from within Lot 1817 despite 3 systematic fauna surveys. Prior to vegetation clearing all fauna will be translocated from the demarcated clearing area. Clearing will include searching of any tree hollows where the species may be denning.
Reduce the area of occupancy of the species	No	The Project will not reduce the area of occupancy for this species
Fragment an existing population into two or more populations	No	The Project will not fragment the habitat of this species. The potentially suitable habitat for the Northern Quoll is widespread in the Darwin region (Section 3.2.6). Removal of potentially suitable habitat in Lot 1817 will not reduce the connectivity of the remaining suitable habitat in the Middle Arm area.

Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Suitable habitat occurs in the Eucalypt Woodland habitat of Lot 1817, of which 92.5 ha is proposed to be cleared. No critical habitat for Northern Quoll is considered to occur in Lot 1817 as the Northern Quoll has not been recorded across 3 systematic fauna surveys. Risks associated with the Project that may impact the quality of remnant potential habitats have a residual risk of Low to Medium.
Disrupt the breeding cycle of a population	No	The Project will not disrupt the breeding cycle as no Northern Quoll have been recorded in Lot 1817.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The Project proposes to clear 92.5 ha of potentially suitable Eucalyptus Woodland habitat. Loss of the potentially suitable habitat will be a 0.01%* reduction of the total available habitat in the Darwin region. No impacts originating from the project will cause habitat degradation for the Northern Quoll that would cause the species 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	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation and competition risk to fauna within and adjacent to Lot 1817 were determined to be Low. Sightings of introduced predators in Lot 1817 will be recorded and if introduced predators are found to be increasing control measures will be implemented in consultation with key stakeholders such as the DEPWS Flora and Fauna Branch. The Project will remove 9.5 ha of breeding habitat for the Cane Toad, which is a threatening process for the Northern Quoll. Active management of feral fauna as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The EPBC Act referral guideline for the endangered northern quoll CoA (2016) has Mitigation Objectives for the Northern Territory which are to: *Ensure appropriate land management (i.e. reducing high fuel loads through weed control and feral animal control).* The Project is not in contravention of these objectives. The Project has committed to the eradication of Gamba Grass from the site, a weedy grass that currently presents high fire risk. Cane Toads are a feral animal currently present at the Site that are a significant threat to the Northern Quoll. The Project will remove 95% of the existing breeding habitat for Cane Toad at the Site. All introduced fauna will be recorded and if found to be increasing control measures will be implemented. CoA (2016) lists Threats and key impacts to Northern Quoll as *Habitat clearing, modification or land use change, Urbanisation, Introduction and increases of invasive species, Pastoralism, Traffic and Inappropriate fire regimes*. The Project has minimised habitat clearing through the utilisation of land that is previously disturbed and currently in a degraded condition with a high level of introduced species and fire risk. The

		modification and land use change is planned in a way that minimises changes to aspects like hydrological processes. The Project will reduce the breeding habitat of Cane Toad by 95%. This introduced species poses a particular threat to Northern Quoll. Domestic dogs will also be reduced at the Site due to restriction of Public access. The risk of increased invasive species at the Project is Low. There is no pastoralism associated with the Project. At Construction and Operations respectively the Project is likely to comprise 4 and 14% respectively of the traffic on Channel Island Road. The use of busses is also considered to be an option for further reduction in traffic through Operations. It is expected that the majority of traffic movemetns will occur during the day when Norhtern Quoll are sleeping. The risk of vehicle strike as a result of the Project is Low. Management of weedy grasses including the eradication of Gamba Grass coupled with the restriction of Public access to the site will reduce the risk of fire at the Project. The Project does not substantially contribute to the key threats to Northern Quoll.

*Figures used to calculate the regional extent of the vegetation type were sourced from the digitization of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000)

Table 9-33. Significant Impact Assessment for the Black-footed Tree-rat (*Mesembriomys gouldii gouldii*)

Endangered species Significant impact criteria. An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	No	The Project has the potential to impact the size of the population for this species during land clearing activities. It is possible that Black-footed Tree-rat individuals could be killed through vehicle strike during clearing. To avoid this risk, prior to vegetation clearing fauna will be translocated from the demarcated clearing area so that no individuals of this species will be killed as a result of the Project. Clearing will include searching of any tree hollows and *Pandanus* foliage where the species may be denning. Clearing techniques will be used that minimise the risk of fauna being killed, including the use of a fauna spotter/catcher during clearing activities. Animals removed from vegetation for clearing will likely be moved to the large area of intact habitat to the east of Lot 1817, if that is deemed suitable by DEPWS and DAWE. This habitat is known to be suitable for Black-footed Tree-rat and would allow retention of the local population size and genetic diversity in the locality.
Reduce the area of occupancy of the species	No	The Project will initially reduce the area of occupancy for this species by 92.5 ha however TNG proposes to rehabilitate the degraded and completely degraded areas outside of the

		Development Envelope (64 ha) to mitigate the loss. There would be a residual loss of 28.5 ha. The 43 ha of suitable habitat that are to be retained in Lot 1817 is currently fragmented by degraded areas, threatened by weedy grass infestation that increases risk of inappropriate fire and frequented by introduced predators. Improving connectivity of the remnant habitat through rehabilitation of the 64 ha of undeveloped land would include eradication of weedy grasses, appropriate fire management and revegetation using species that are suitable for Black-footed Tree-rat habitat as set out in the Rehabilitation Management Plan (EIS Supplement Appendix B). This area is not on the periphery or furthest extent of the known population distribution within the Darwin region and would not reduce the overall occupancy of the species in the region or territory. The species is known to have large home ranges (up to 67 ha) and travel large distances (up to 2 km in a single night) therefore a negligible percentage of local habitat will be lost. Indirect impacts are expected to have a limited or local impact and not expected to reduce the habitat quality to the extent that Black-footed Tree-rat will be impacted in the remnant habitat. The species is currently present in areas less than 100 m from the Adelaide-Darwin Railway line and Channel Island Road, indicating a level of resilience to noise and light.
Fragment an existing population into two or more populations	No	Lot 1817 is already a fragmented habitat and the small area of remnant bushland that will be lost for the Project is unlikely to further fragment the population that persists in that area, given that most of the Development Envelope is centred on previously disturbed land. The Project would not be expected to fragment such a mobile species as the Black-footed Tree-rat. The population of Black-footed Tree Rat within Lot 1817 is already fragmented from the more intact habitat to the east by the presence of Channel Island Road and the Adelaide-Darwin Railway. The Project will not create a significant increase to the traffic volume on these transport networks with a 4% increase during construction and 14% increase during operations[†] with the majority of traffic movements occurring during daylight hours when the Black-footed Tree-rat is asleep.
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Whilst the 92.5 ha of Eucalypt Woodland that is demarcated for clearing is currently used for activities such as foraging and possibly breeding, the area is not necessary for the survival of the individuals that presently use the area. Black-footed Tree-rats have a home range of 67.3 ± 10.4 ha in un-fragmented open forests and 27.1 ± 8.4 ha in fragmented habitat (Rankmore 2006). It is likely they are using a diversity of locations within these home ranges. A large and intact area of Black-footed Tree-rat habitat occurs to the east of the Project and it is estimated that the vegetation clearing for the Project will reduce the available habitat for the

		species in the locality by 4%. Sufficient high quality habitat is locally available that the habitat lost as a result of the Project is not critical to the survival of the species in the locality or regionally.
Disrupt the breeding cycle of a population	No	The Black-footed Tree-rat is thought to live for approximately 3-5 years and reach reproductive maturity at about 3 months (Woinarksi *et al*., 2014). Breeding may occur throughout the year but studied Darwin populations peak in August-September (Rankmore, 2006). It is therefore possible that land clearing of a patch of remnant bushland coincides with the breeding of a pair of Black-footed Tree-rat for one season. If so, that could disrupt that pair's breeding success for that particular year. However, that pair may relocate to another site and successfully breed that year or in future years. As such, the worst-case scenario is a pair not being able to breed in one season. This does not constitute a disruption to the breeding cycle of a local population. The Black-footed Tree-rat within Lot 1817 are part of the central Middle Arm population. While the number of Black-footed Tree-rat within the site and population is not known, the area to be disturbed is approximately 4% of the habitat within central Middle Arm where the species has been confirmed to occupy (**Figure 3-6**). It is considered that no impact will occur to interrupt the breeding over the remaining 96% of the local populations habitat, and any disruption within the Project area would be for a maximum of one breeding season.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The Project proposes to clear 92.5 ha of Eucalyptus Woodland habitat. Loss of 92.5 ha of habitat will be a 1%* reduction of the total available habitat in the Blackmore and Elizabeth Rivers Catchment, and an estimated 4% reduction in the habitat occupied by the species in the Middle Arm area (**Figure 3-6**). The species is unlikely to decline as a result of disturbance at this scale, given the highly disturbed nature of the land in Lot 1817 and the high level of suitable habitat in close proximity. Following the rehabilitation of the 64 ha of degraded and completely degraded land in Lot 1817 there will be a residual loss of 28.5 ha of Eucalypt Woodland habitat, representing a 1.3% loss of the area currently known to be occupied by the species in the Middle Arm area. Risks associated with the Project that may impact the quality of remnant potential habitats (e.g. noise, light, pollution, changed hydrology) have a residual risk of Low to Medium and a scale of limited or localised. It is not expected that the habitat loss arising from the Project will cause habitat degradation for Black-footed Tree-rat that would cause the species to decline. The proposed management of degraded land within Lot 1817 will reduce the currently high risk of inappropriate fire, human disturbance and introduced fauna which will benefit the species within Lot 1817 and also the wider population in the high quality intact habitats to the east.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation and competition risk to fauna within and adjacent to Lot 1817 were determined to be Low. Sightings of introduced predators in Lot 1817 will be recorded and if introduced predators are found to be increasing control measures will be implemented in consultation with key stakeholders such as the DEPWS Flora and Fauna Branch. Management of Lot 1817 as a result of the Project is expected to reduce the risk of feral fauna that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The Conservation Advice for the Black-footed Tree-rat (DoE, 2015) states the Primary Conservation objective to: *Stabilise or increase subpopulations across range, through amelioration of existing threats* The size of the local population of Black-footed Tree-rat will not be impacted by the Project. Translocation of animals prior to clearing will ensure no Black-footed Tree-rat are killed as a result of the Project. Whilst the release sites are yet to be determined in collaboration with DEPWS and DAWE, it is anticipated that animals will be moved to the intact habitat to the east and thus remain in the same sub-population. Remnant habitats will be retained in Lot 1817 outside of the Development Envelope. Existing threats are introduced predators, inappropriate fire regimes and habitat fragmentation. The Project will eradicate Gamba Grass and restrict access to the public. This will reduce the risk of fire and the frequency of domestic dogs at the Site. The Project will also control introduced predators if they are recorded to be increasing at the Site. TNG have committed to rehabilitation of land outside the Development Envelope in a Degraded and Completely Degraded condition. This will reduce the fragmentation of remnant habitats. The Project is not in contravention of the Conservation Advice.

†Based on 2014 peak traffic on the Channel Island Road

*Figures used to calculate the regional extent of the vegetation type were sourced from the digitization of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000)

Table 9-34. Significant Impact Assessment for the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*).

Vulnerable species Significant impact criteria. An action is likely to have a significant impact on a Vulnerable 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	No	Bare-rumped Sheathtail Bat has not been recorded in Lot 1817 despite the deployment of bat detectors. DAWE (2020) and TSSC (2016) report no recent records of this species from the Top End, however Atlas of Living Australia has some scattered historic records in the Darwin region and a recent record south of Darwin, and the DEPWS has recorded the species in recent unpublished surveys of the Middle Arm locality. It is not expected that the Project will impact the size of the population for this species. No individuals of this species will be killed as a result of the Project. Prior to vegetation clearing all fauna will be translocated from the demarcated clearing area, including clearing of any tree hollows where the species may be roosting.
Reduce the area of occupancy of an important population	No	The Project will not reduce the area of occupancy for this species, as it is not known to occur within Lot 1817.
Fragment an existing important population into two or more populations	No	The Project will not fragment the habitat of this species. The potentially suitable habitat for the Bare-rumped Sheathtail Bat is widespread in the Darwin region (Section 2.3.1). Removal of potentially suitable habitat in Lot 1817 will not reduce the connectivity of the remaining suitable habitat in the Middle Arm area.
Adversely affect habitat critical to the survival of a species	No	The project is not expected to adversely affect habitat critical to the survival of this species. Suitable habitat occurs in the Eucalypt Woodland habitat of Lot 1817, of which 92.5 ha is proposed to be cleared. No critical habitat for Bare-rumped Sheathtail Bat is considered to occur in Lot 1817 as the Bare-rumped Sheathtail Bat has not been recorded as present. Risks associated with the Project that may impact the quality of remnant potential habitats have a residual risk of Low to Medium.
Disrupt the breeding cycle of an important population	No	As the Bare-rumped Sheathtail Bat has not been recorded in Lot 1817 it is not expected that the Project will disrupt the breeding cycle.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The Project proposes to clear 92.5 ha of potentially suitable Eucalyptus Woodland habitat. Loss of the potentially suitable habitat will be a 0.01%* reduction of the total available habitat in the Darwin region. Within the Eucalypt Woodland habitat in the Project area only 3.5 ha is considered Significant Vegetation in that it supports the large trees capable of providing the tree hollow habitats suitable for roosting for this species. No impacts originating from the project will cause habitat degradation for the Bare-rumped Sheath-tailed Bat that would cause the species 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	No	The residual risk of attracting introduced predators to the Project area and thus increasing the predation risk to fauna within and adjacent to Lot 1817 were determined to be Low. Sightings of introduced predators in Lot 1817 will be recorded and if introduced predators are found to be increasing control measures will be implemented in consultation with key stakeholders such as the DEPWS Flora and Fauna Branch.

		Active management of feral predators as a result of the Project is expected to reduce the risk that is already present at the site.
Introduce disease that may cause the species to decline,	No	There are no disease risks associated with the Project.
Interfere with the recovery of the species.	No	The Project will not interfere with the recovery of the species.

*Figures used to calculate the regional extent of the vegetation type were sourced from the digitization of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000)

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11 APPENDICES

11.1 Appendix A.

Conservation Categories

Species listed as Threatened under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (EPBC Act) are described under the categories listed in Box A-1.

Box A-1. Categories of threatened species under the EPBC Act.

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Part 13 Species and communities
Division 1 Listed threatened species and ecological communities

179 Categories of threatened species

(1) A native species is eligible to be included in the ***extinct*** category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.

(2) A native species is eligible to be included in the ***extinct in the wild category*** at a particular time if, at that time:
  (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
  (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

(3) A native species is eligible to be included in the ***critically endangered*** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

(4) A native species is eligible to be included in the ***endangered*** category at a particular time if, at that time:
  (a) it is not critically endangered; and
  (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

(5) A native species is eligible to be included in the ***vulnerable*** category at a particular time if, at that time:
  (a) it is not critically endangered or endangered; and
  (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

(6) A native species is eligible to be included in the ***conservation dependent*** category at a particular time if, at that time:
  (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or
  (b) the following subparagraphs are satisfied:
    (i) the species is a species of fish;
    (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised;
    (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory;
    (iv) cessation of the plan of management would adversely affect the conservation status of the species.

(7) In subsection (6):
  (a) ***fish*** includes all species of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals or marine reptiles.

Communities listed as Threatened under the EPBC Act are described under the categories listed in Box A-2.

Box A-2. Categories of threatened communities under the EPBC Act.

182 Critically endangered, endangered and vulnerable communities

(1) An ecological community is eligible to be included in the ***critically endangered*** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

(2) An ecological community is eligible to be included in the ***endangered*** category at a particular time if, at that time:

  (a) it is not critically endangered; and

  (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

(3) An ecological community is eligible to be included in the ***vulnerable*** category at a particular time if, at that time:

  (a) it is not critically endangered nor endangered; and

  (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Species listed as Migratory under the EPBC Act are defined in Box A-3.

Box A-3. Migratory species defined under the EPBC Act

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Part 13 Species and communities
Division 2 Migratory species

209 Listed migratory species

(1) In this Act:

migratory species has the meaning given by Article I of the Bonn Convention.

Convention on the Conservation of Migratory Species of Wild Animals
Article I
Interpretation

1. For the purpose of this Convention:

  a) "Migratory species" means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.

From: Convention on the Conservation of Migratory Species 1979. Bonn, Germany.

In the Northern Territory (NT) every species of plant and animal is classified according to the International Union for the Conservation of Nature (IUCN) red list categories and criteria (Box 5). Species that have been classified as extinct in the wild, critically endangered, endangered or vulnerable are threatened species and have greater protection in the NT under the *Territory Parks and Wildlife Conservation Act 1976* (**TPWC Act**).

Box 5. IUCN Red List categories and Criteria.

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycles and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are often included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, or a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

11.2 APPENDIX B.

Animal Plant Mineral (AMP) (2019). Darwin Processing Facility Biological Survey. Middle Arm, Darwin Harbour NT. Technical Report for TNG Limited. October 2019.

Report included in full as Appendix J in the Draft EIS.