TNG LIMITED

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Darwin Processing Facility
Significant Fauna Impact Assessment

Middle Arm, Darwin Harbour, NT

Prepared on behalf of TNG Limited by:

Animal Plant Mineral Pty Ltd

Lot 1817, Hundred of Ayers, Middle Arm Peninsula, Darwin Harbour

CONTENTS

1 Introduction 7

1.1 Background 7

1.2 Project Description 7

1.3 Scope and Objectives 9

1.4 Assessment of Significance 10

1.4.1 Fauna Habitats 10

1.4.2 Fauna Species 10

2 Survey Effort 10

3 Key Receptors 12

3.1 Species Occurring in the Study Area 12

3.1.1 *Numenius madagascariensis* – Far Eastern Curlew 12

3.1.2 *Charadrius leschenaultii* – Greater Sand Plover 17

3.1.3 *Mesembriomys gouldii gouldii* – Black-footed Tree-rat (Kimberley and mainland Northern Territory subspecies), Djintamoonga, Manbul 20

3.1.4 *Rattus tunneyi* – Pale Field Rat 25

3.1.5 *Uperoleia daviesae* – Howard River Toadlet 29

3.1.6 Migratory species 31

3.2 Species Likely to Occur in the Study Area 34

3.2.1 *Calidris canutus* – Red Knot 34

3.2.2 *Calidris ferruginea* – Curlew Sandpiper 37

3.2.3 *Calidris tenuirostris* – Great Knot 40

3.2.4 *Charadrius mongolus* – Lesser Sand Plover 43

3.2.5 *Limosa lapponica* – Bar-tailed Godwit 46

3.2.6 *Dasyurus hallucatus* – Northern Quoll 49

3.2.7 *Varanus panoptes* – Yellow-spotted Monitor 52

3.2.8 *Saccolaimus saccolaimus nudicluniatus* – Bare-rumped Sheathtail Bat 55

3.3 Species Possibly Occurring in the Study Area 58

3.3.1 *Antechinus bellus* – Fawn Antechinus 58

3.3.2 *Varanus mertensi* – Mertens' Water Monitor 61

3.3.3 Migratory species possibly occurring in the Study area 64

3.4 Fauna Habitats 71

3.5 Habitat Features 74

3.5.1 Sensitive and Significant Vegetation 74

3.5.2 Remnant Mixed Woodland 74

3.5.3 Waterbird Aggregations 75
3.5.4 Saltpan within Lot 1817 85
4 Sources of Potential Impacts 85
4.1 Vegetation Clearance 86
4.2 Habitat Fragmentation 86
4.3 Human Disturbance and Vehicle Strike 86
4.4 Introduced Species 87
4.4.1 Introduc*ed Fauna* 87
4.4.2 Introduced flora 88
4.5 Noise and Light 88
4.6 Inappropriate or Ineffective Rehabilitation 90
4.7 Altered Hydrology and Impacts on Surface Water and Groundwater Systems 90
4.8 Lightning and Uncontrolled Fire 91
4.9 Uncontrolled Contaminated Discharges, Acid Sulphate Soils, Water Quality Impacts, And Groundwater Contamination, Bioaccumulation of Toxic Substances up the Food Chain 92
4.10 Erosion and Sedimentation 92
4.11 Ponds And Fauna Entrapment 92
4.12 Summary impact sources and outcomes 93
5 Criteria for Assessing Impacts 97
5.1 Northern Territory 97
5.2 Matters of National Environmental Significance 97
6 Impact Assessment of Key Receptors 98
6.1 Impacts to Fauna Habitats 98
6.2 Potential Impacts to Habitat Features 99
6.3 Potential Impacts on Fauna Species 101
6.3.1 Potential Impacts on Species Occurring in the Study Area 102
6.3.2 Potential Impacts on Species Likely to or Possibly Occurring in the Study Area 104
6.3.3 Potential impacts to species – species by species assessment 104
7 Application of the Mitigation Heirachy 121
8 Residual Risk Assesment 124
9 MNES Significant Impact Assessments 127
10 References 165
11 Appendices 171
11.1 Appendix A. 172
11.2 Appendix B. 175

FIGURES

Figure 1-1. Lot 1817 Hundred of Ayres Study Area 8
Figure 3-1. Distribution of *Numenius madagascariensis* (Far Eastern Curlew) in Darwin Harbour and (inset) in Australia 15
Figure 3-2. Distribution of Far Eastern Curlew and migratory shorebird habitats in relation to the Development Envelope 16
Figure 3-3. Distribution of *Charadrius leschenaultii* (Greater Sand Plover) in Darwin Harbour and (inset) in Australia 19
Figure 3-4. Distribution of the Black-footed Tree Rat records in the Darwin region and (insets) in the Top End of the NT and in Australia 22
Figure 3-5. Distribution of the Black-footed Tree-rat and suitable habitat in Lot 1817 24
Figure 3-6. Black-footed Tree-rat locations recorded by DEPWS Flora and Fauna Division on Middle Arm 25
Figure 3-7. Pale Field Rat locations in the Darwin Region and (insets) the Top end of the NT and Australia 27
Figure 3-8. Distribution of Pale Field Rat records in Lot 1817 and suitable habitat in relation to the Development Envelope 28
Figure 3-9.Distribution of Howard River Toadlet records in the Darwin Region and in the Top End of the NR 30
Figure 3-10. Distribution of Red Knot records in Darwin Harbour and (inset) in Australia. 36
Figure 3-11. Distribution of Curlew Sandpiper records in Darwin Harbour Proper and (inset) in Australia. 39
Figure 3-12. Distribution of *Calidris tenuirostris* (Great Knot) in Darwin Harbour and (inset) in Australia. 42
Figure 3-13. Distribution of *Charadrius mongolus* (Lesser Sand Plover) in Darwin Harbour and (inset) in Australia 45
Figure 3-14. Distribution of *Limosa lapponica* (Bar-tailed Godwit) in Darwin Harbour and (inset) in Australia 47
Figure 3-15. Distribution of the Northern Quoll records in the Darwin region and (insets) in the Top End of the NT and in Australia 51
Figure 3-16. Distribution of Yellow Spotted Monitor records in the Darwin Region, in the Top End of the NT and in Australia 54
Figure 3-17. Distribution of Bare-rumped Sheathtail Bat habitat in the Darwin region and (insets) records in the Darwin region, Top End of the NT and in Australia 57
Figure 3-18. Distribution of Fawn Antechinus records in the Darwin Region and (inset) in the NT. 60
Figure 3-19. Distribution of Mertens' Water Monitor records in the Darwin Region and in the Top End of the NT and in Australia 63
Figure 3-20. Fauna habitats and location of conservation significant fauna records 72
Figure 3-21. Locations of Migratory shorebird habitats in the Darwin Harbour. 77
Figure 3-22. Distribution of migratory shorebird habitats types in the Darwin Harbour 83

TABLES

Table 1-1. Definitions and terms for fauna of conservation significance 10
Table 2-1. Methodology and survey effort 11
Table 3-1. Migratory species recorded in the Study area 31
Table 3-2. Migratory species possibly occurring in the Study area 65
Table 3-3. Value of habitats in the Study Area 73
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 79
Table 4-1. Summary of the relationship between impact sources and outcomes on fauna that may arise from the Project 94
Table 5-1. Impact criteria used to assess the extent for each potential impact source 97
Table 6-1. Habitats to be cleared 99
Table 6-2. Potential impacts to significant fauna from sources originating from the Project 105
Table 7-1. Mitigation and management strategies for each impact source potentially arising from the Project. 122

Table 8-1. Residual risk assessment 125
Table 9-1. Significant Impact Assessment for the Red Knot (*Calidris canutus*) 127
Table 9-2. Significant Impact Assessment for the Curlew Sandpiper (*Calidris ferruginea*) 129
Table 9-3. Significant Impact Assessment for the Great Knot (*Calidris tenuirostris*) 130
Table 9-4. Significant Impact Assessment for the Greater Sand Plover (*Charadrius leschenaultii*) 131
Table 9-5. Significant Impact Assessment for the Lesser Sand Plover (*Charadrius mongolus*) 133
Table 9-6. Significant Impact Assessment for the Far Eastern Curlew (*Numenius madagascariensis*) 135
Table 9-7. Significant Impact Assessment for the Painted Sipe (*Rostratula australis*) 139
Table 9-8. Significant Impact Assessment for the Partridge Pigeon (eastern) (*Geophaps smithii smithii*) 139
Table 9-9. Significant Impact Assessment for the Red Goshawk (*Erythrotriorchis radiatus*) 140
Table 9-10. Significant Impact Assessment for the Fork-tailed Swift (*Apus pacificus*) 141
Table 9-11. Significant Impact Assessment for the Common Sandpiper 141
Table 9-12. Significant Impact Assessment for the Ruddy Turnstone (*Arenaria interpres*) 142
Table 9-13. Significant Impact Assessment for the Sharp-tailed Sandpiper (*Calidris acuminata*) 142
Table 9-14. Significant Impact Assessment for the Sanderling (*Calidris alba*) 143
Table 9-15. Significant Impact Assessment for the Red-necked Stint (*Calidris ruficollis*) 144
Table 9-16. Significant Impact Assessment for the Long-toed Stint (*Calidris subminuta*) 144
Table 9-17. Significant Impact Assessment for the Little Ringed Plover (*Charadrius dubius*) 145
Table 9-18. Significant Impact Assessment for the Oriental Plover (*Charadrius veredus*) 145
Table 9-19. Significant Impact Assessment for the Asian Dowitcher (*Limnodromus semipalmatus*) 146
Table 9-20. Significant Impact Assessment for the Black-tailed Godwit (*Limosa limosa*) 146
Table 9-21. Significant Impact Assessment for the Little Curlew (*Numenius minutus*) 147
Table 9-22. Significant Impact Assessment for the Whimbrel (*Numenius phaeopus*) 148
Table 9-23. Significant Impact Assessment for the Pacific Golden Plover (*Pluvialis fulva*) 149
Table 9-24. Significant Impact Assessment for the Grey Plover (*Pluvialis squatarola*) 150
Table 9-25. Significant Impact Assessment for the Grey-tailed Tattler (*Tringa brevipes*) 151
Table 9-26. Significant Impact Assessment for the Wood Sandpiper (*Tringa glareola*) 152
Table 9-27. Significant Impact Assessment for the Common Greenshank (*Tringa nebularia*) 153
Table 9-28. Significant Impact Assessment for the Marsh Sandpiper (*Tringa stagnatilis*) 153
Table 9-29. Significant Impact Assessment for the Terek Sandpiper (*Xenus cinereus*) 154
Table 9-30. Significant Impact Assessment for the Eastern Osprey (*Pandion cristatus*) 155
Table 9-31. Significant Impact Assessment for the Fawn Antechinus (*Antechinus bellus*) 156
Table 9-32. Significant Impact Assessment for the Northern Quoll (*Dasyurus hallucatus*) 157
Table 9-33. Significant Impact Assessment for the Black-footed Tree-rat (*Mesembriomys gouldii gouldii*) 159
Table 9-34. Significant Impact Assessment for the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*). 163

LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITIONS

Abbreviation	Meaning
AEP	Annual Exceedance Probability
APM	Animal Plant Mineral Environmental Consultants
ASS	Acid Sulfate Soils
BCF	Burrel Creek Formation
DAWE	Department of Agriculture, Water and the Environment
DPC	Darwin Port Corporation
DEPWS	Department of Environment, Parks and Water Security
EAAF	East Asian-Australasian Flyway
EIS	Environmental Impact Statement

Abbreviation	Meaning
EN	Endangered
EP Act	Northern Territory *Environmental Protection Act (2019*)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FMP	Fire Management Plan
IUCN	International Union for the Conservation of Nature
MNES	Matters of National Environmental Significance
NIDEM	National Intertidal Digital Elevation Model
NSW	New South Wales
NT	Northern Territory
QLD	Queensland
SPRAT Database	Species Profile and Threats Database
THE PROJECT	Darwin Processing Facility at Lot 1817, Hundred of Ayers, Middle Arm Industrial Precinct, (658 Channel Island Road) Wickham
TNG	TNG Limited
TPWC Act	Territory Parks and Wildlife Conservation Act 2000 (NT)
VU	Vulnerable
WA	Western Australia
WRP	Water Recycling Plant

UNITS OF MEASURE

Unit	Meaning
°	degrees
%	Percent
cm	Centimetres
db(A)	Decibels
g	Gram
ha	Hectare
km	Kilometre
m	Metre
mm	Millimetre
Tpa	Tonnes per annum

1 INTRODUCTION

1.1 BACKGROUND

TNG Limited (**TNG**) commissioned Animal Plant Mineral Environmental Consultants (**APM**) to undertake a significant fauna impact assessment (this Assessment) for the development of the proposed Darwin Processing Facility at Lot 1817, Hundred of Ayers, Middle Arm Industrial Precinct, (658 Channel Island Road) Wickham (the **Project**). The Project is approximately 16 kilometres (**km**) south east of Darwin, Northern Territory (**NT**).

The area considered for this Assessment, and during previous baseline surveys, covers approximately 1000 hectares (**ha**) and is hereafter to referred to as the Study Area (**Figure 1-1**). This Assessment is based on data obtained and analysed during desktop studies and baseline surveys conducted over the area, via numerous field trips, between 2016 and 2019 (APM 2019).

1.2 PROJECT DESCRIPTION

The purpose of the Project is processing magnetite concentrate to produce higher value products for export from East Arm Wharf to international customers. The site is within the Litchfield Council Local Government Area and is adjacent to Elizabeth River, near the Elizabeth River Bridge. Access to the site is via Channel Island Road and is approximately 30 km by road from Darwin.

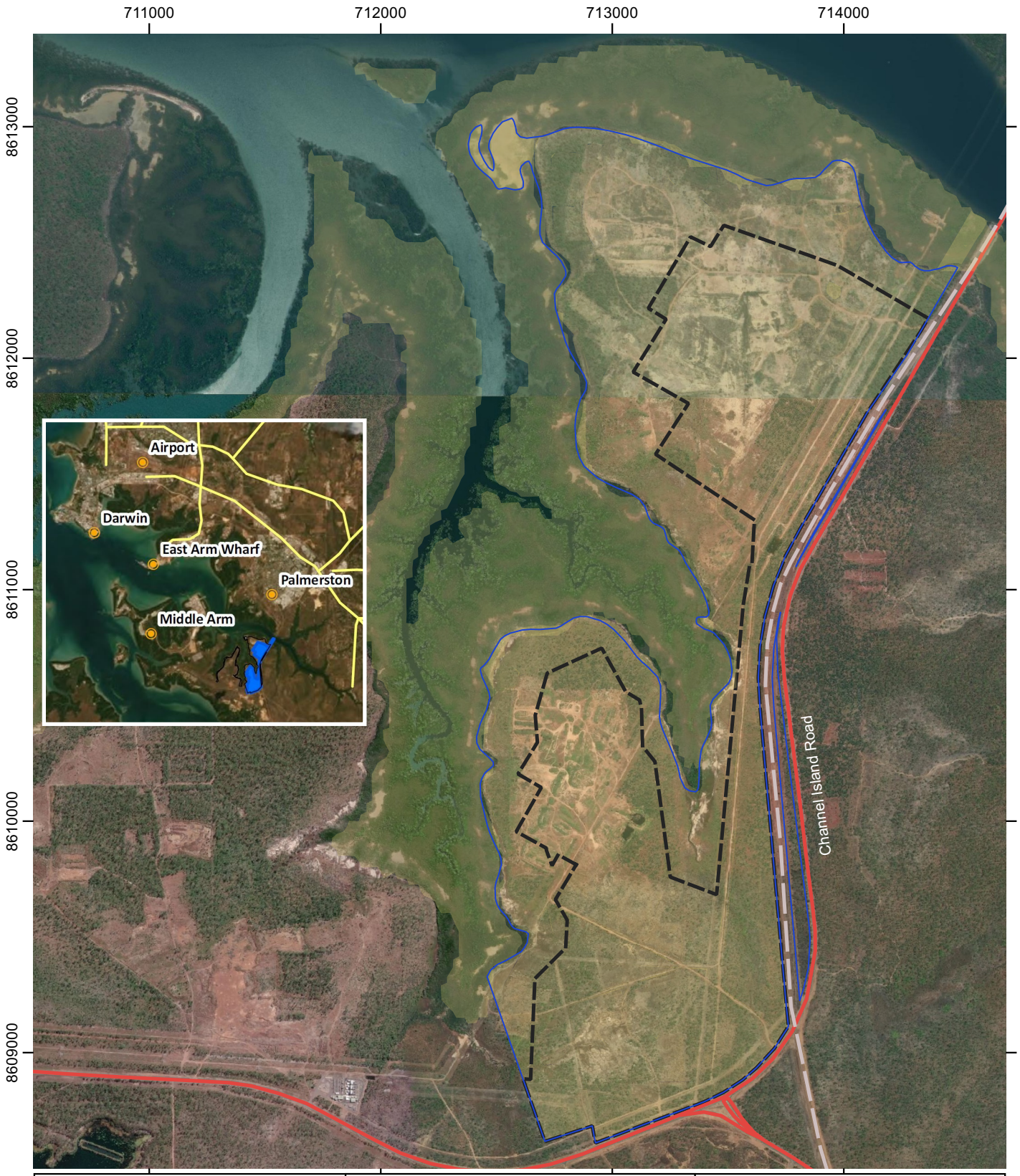
The Project will comprise:

- clearing of a partially vegetated allotment formerly utilised for extractive industries;
- construction of a magnetite concentrate Processing Facility;
- construction of a rail siding, unloading and loadout facilities on the Adelaide to Darwin railway;
- unloading of concentrate from trains at the rail siding;
- refining of concentrate;
- recycling of process water through the use of a waste-water treatment plant; and
- loading of trains at the rail siding with Processing Facility products and transport via rail to East Arm Wharf.

The construction period is anticipated to be 24 months, continuing over both wet and dry seasons. The design life of the Darwin Processing Facility is 40 years. Processing of concentrate would occur at a rate of 700,000 tonnes per annum (**tpa**). The life of the processing facility mirrors the production of concentrate from the Mount Peake Mine, the primary source of concentrate for the Project.

The Project is contained within the proposed 1,000 ha Middle Arm Industrial Precinct, a Land Development Corporation initiative that provides access to industrial and commercial land under the *Land Development Corporation Act 2003*. The Precinct is designed to accommodate large strategic industrial lots for downstream gas processing and gas related industry, with access to an extensive corridor network to carry utilities, gas, feedstock, and products. The 2015 Darwin Regional Land Use Plan identifies land on Middle Arm as an area with potential for strategic industrial development, including additional deep-water port development. Land to the east of Lot 1817 is zoned Utilities, Main Roads, Proposed Main Roads, and Railway. Lot 1817 has previously been used for sand mining with 65 % of the Lot previously disturbed and in Degraded condition.

Land to the north, south, and west contains intertidal areas and mangrove forests that connect the site to the Elizabeth River and Darwin Harbour, and has been zoned for conservation (DLPE, 2015). Development of the Darwin Processing Facility will be confined to the area of Lot 1817 adjacent to Channel Island Road. In total, Lot 1817 covers 507 ha. The Project has been allocated a Development Envelope of 270.5 ha within Lot 1817 (**Figure 1-1**) that maximises the use of the previously disturbed land.



Legend

- Study Area
- EIS Supplement Development Envelope
- Lot 1817 boundary
- Adelaide-Darwin Railway line
- Roads

TNG Darwin Processing Facility
Significant Fauna Impact Assessment

Figure 1-1. Lot 1817 Hundred of Ayres Study Area

TNG LIMITED

0 250 500 m

Scale when printed in A4 is 1: 23,000
Date drawn: 19/01/2020
CRS: GDA 1994 MGA Zone 52

1.3 SCOPE AND OBJECTIVES

The overarching objective of this Assessment was to identify and assess the potential impact of the Project on fauna habitat features, significant fauna assemblages and vertebrate fauna of conservation significance within the Study Area. This is achieved by:

- Identification of potential key receptor species and habitats relevant to this Assessment. This Assessment is specific to the species of conservation significance and fauna assemblages identified as potentially occurring within the Study Area and/or those that have previously been recorded within the Study Area;
- Identification of potential impacts for the potential key receptor species and habitats.
- Assessment of the significance of these potential impacts on the potential key receptor species, in relation to extent, duration, magnitude (local and regional) and certainty
- Identification of areas of potential management to mitigate the impacts of these sources on the potential key receptor species and habitats; and
- Calculation of the initial and residual risk to fauna and fauna habitat features.

This Assessment was carried out in a manner consistent with the following documents developed by the Commonwealth Department of Agriculture, Water and the Environment (**DAWE** - formerly the Department of Environment and Energy) and the Northern Territory Department of Environment, Parks and Water Security (**DEPWS**; formerly the Department of Environment and Natural Resources):

- DoE (2013) Matters of National Environmental Significance: Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999;
- NT EPA (2013) Guidelines for Assessment of Impacts on Terrestrial Biodiversity Version 2.0;
- NT EPA (2020) Environmental Factors and Objectives;
- CoA (2015) Conservation Advice *Mesembriomys gouldii gouldii* Black-footed tree-rat (Kimberley and mainland Northern Territory);
- DoE (2015a) Conservation Advice *Calidris ferruginea* curlew sandpiper
- DoE (2015b) Conservation Advice *Numenius madagascariensis* eastern curlew
- TSSC (2016a) Conservation Advice *Calidris canutus* Red knot
- CoA (2016) EPBC Act referral guideline for the endangered northern quoll
- Hill and Ward (2010) National Recovery Plan for the Northern Quoll *Dasyurus hallucatus*
- DoE (2016) *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) referral guideline for the endangered Northern Quoll (*Dasyurus hallucatus*);
- TSSC (2016d) Conservation Advice *Charadrius mongolus* Lesser sand plover
- TSSC (2016c) Conservation Advice Charadrius leschenaultii Greater sand plover
- DEE (2017) Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*);
- DEWHA (2008) Threat abatement plan for predation by the European red fox
- DoE (2015) Threat abatement plan for predation by feral cats
- DoEE (2018)Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans

1.4 ASSESSMENT OF SIGNIFICANCE

1.4.1 Fauna Habitats

Fauna habitats may be significant if they provide habitat important to the life history of a significant species, *i.e*. breeding, feeding and roosting or aggregation areas, or where they are unique or isolated habitats, for example wetlands, in the landscape or region (EPA, 2016).

This Assessment identifies significant fauna habitats in relation to the Project.

1.4.2 Fauna Species

Species listed under the EPBC Act are considered to be of conservation significance under seven categories (**Table 1-1**). Species listed as threatened or migratory under the EPBC Act are also considered Matters of National Environmental Significance (**MNES**).

In the 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. 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 2000 (NT)* **(TPWC Act).**

For the purpose of this assessment, fauna species are considered significant if they are MNES under the EPBC Act or are listed under the TPWC Act.

Applicable legislation and status codes for fauna species are that are considered significant for this assessment are summarised in **Table 1-1** with descriptions in Appendix A.

Table 1-1. Definitions and terms for fauna of conservation significance

Act	Conservation categories	Code
EPBC Act	Extinct	EX
	Extinct in the Wild	EW
	Critically Endangered	CR
	Endangered	EN
	Vulnerable	VU
	Conservation Dependent	CD
	Migratory	Mi
TPWC Act	Extinct in the Wild	EW
	Critically Endangered	CR
	Endangered	EN
	Vulnerable	VU

2 SURVEY EFFORT

Terrestrial Fauna surveys have been initiated by TNG for Lot 1817 and surrounds from 2016 to 2019. The methods and survey effort are summarised in **Table 2-1**. The full survey reports are in APM (2019; Appendix B). The Study Area for Terrestrial Fauna is shown in **Figure 1-1**. The Study Area extends beyond the boundary of Lot 1817 to capture any areas that may be impacted by the Project.

Table 2-1. Methodology and survey effort

Survey type	GHD 2016 (Birds)	GHD 2017 (Fauna)	APM 2018 (Fauna incl. birds)	APM 2019 (Birds)	APM2019 (Mammals)
Total Survey Effort	5 field days.	6 sites, > 4 trap-nights per site.	4 field days.	4 field days.	5 trap lines, 5 trap-nights per line.
Shorebird Surveys					
On foot	6 surveys inside and outside Study Area. 20 hours in total.				
Helicopter			7 surveys, 7 hours in total.		
Boat	6 surveys inside and outside Study Area. 26 hours in total.		2 surveys, 6 hours in total.	4 surveys, 14 hours in total.	
Terrestrial Surveys					
Habitat assessment		~2 hours per site.	Opportunistic assessment over 4 field days.		Opportunistic assessment over 5 field days.
Elliot traps		16 traps per site. 400 trap-nights in total.			30 traps per line. 750 trap-nights in total.
Cage traps		4 traps per site. 100 trap-nights in total.			6 traps per line. 150 trap-nights in total.
Pitfall traps		4 per site. 100 trap-nights in total.			
Funnel traps		8 traps per site. 200 trap-nights in total.			
Nocturnal searches		2x 20-minute searches per site. ~14 searches in total.	4x 40-minute spotlight searches on roads and tracks.		5x ~40-minute searches on roads and tracks.
Bird surveys		>3x 20-minute surveys per site. 18 surveys in total.	5x 20-minute 2 ha surveys. Opportunistic recordings throughout.	17x 20-minute 2 ha surveys. Opportunistic recordings throughout.	
Camera traps		10 locations. 256 trap-nights in total.	6 locations. 11 trap-nights in total.	3 locations. 9 trap-nights in total.	15 locations. 189 trap-nights in total.
Bat detectors		4 survey-nights in total.			29 survey-nights in total.
Significant Species (Significance: TPWC Act/EPBC Act)	Eastern Curlew (VU/CR) Greater Sand Plover (VU/VU) Bar-tailed Godwit (VU/Mi) Common Sandpiper (-/Mi) Common Greenshank (-/Mi) Whimbrel (-/Mi)	Black-footed Tree-rat (VU/EN) Pale Field Rat (VU/-) Saltwater Crocodile (-/Mi) Howard River Toadlet (unconfirmed(VU/-))	Eastern Curlew (VU/CR) Oriental Cuckoo (-/Mi) Common Sandpiper (-/Mi) Common Greenshank (-/Mi) Whimbrel (-/Mi) Little Tern (-/Mi) Black-footed Tree-rat (VU/EN)	Eastern Curlew (VU/CR) Fork-tailed Swift (-/Mi) Common Sandpiper (-/Mi) Common Greenshank (-/Mi)	Black-footed Tree-rat (VU/EN)

3 KEY RECEPTORS

3.1 SPECIES OCCURRING IN THE STUDY AREA

Fourteen significant species have been recorded within the Study Area:

- Eastern Curlew (CR and Mi under the EPBC Act, VU under the TPWC Act)
- Greater Sand Plover (VU and Mi under the EPBC Act and TPWC Acts)
- Black-footed Tree-rat (EN under the EPBC Act, VU under the TPWC Act)
- Pale Field Rat (VU under the TPWC Act)
- Howard River Toadlet (VU under the TPWC Act)
- Common Sandpiper (Mi under the EPBC Act)
- Common Greenshank (Mi under the EPBC Act)
- Whimbrel (Mi under the EPBC Act)
- Little Tern (Mi under the EPBC Act)
- Fork-tailed Swift (Mi under the EPBC Act)
- Oriental Cuckoo (Mi under the EPBC Act)
- Eastern Osprey (Mi under the EPBC Act)
- Saltwater Crocodile (Mi under the EPBC Act)

These species were recorded during the field surveys listed in **Table 2-1**. Each of these species are discussed in further detail below.

3.1.1 *Numenius madagascariensis* – Far Eastern Curlew

3.1.1.1 Description

Numenius madagascariensis is the largest shorebird that migrates to Australia, with a wingspan of up to 110 cm and weight of 900 g. It has a long, downturned bill, long neck, and long legs. Females are slightly larger than males, with a longer bill. The plumage includes heavy, dark patterning on the head and neck, extending to the breast, with narrow dark brown bars on the tail, rump, and vent (DoE, 2015b).

3.1.1.2 Distribution and Habitat

The species breeds in Russia, Mongolia, and northeast China. It migrates south exclusively through the East Asian-Australasian Flyway (**EAAF**), with most individuals spending the non-breeding season in Australia. Within Australia, it is found on the coast of all states. It has a continuous distribution from Barrow Island and Dampier Archipelago in Western Australia (**WA**), through the NT, Queensland (**QLD**), and New South Wales (**NSW**) coasts. In the NT, important sites include the coast around Darwin, Millingimbi to Buckingham Bay area, Roper and Limmen Bight River mouths, and Port McArthur area (DoE, 2015b).

In the non-breeding areas, it inhabits sheltered coasts with large intertidal mudflats or sandflats, and often with beds of seagrass (*Zosteraceae*), in estuaries, bays, harbours, inlets, and coastal lagoons. It is also known to use saltmarsh or mudflats fringed by mangroves, as well as the mangroves. It forages on open/vegetation-free intertidal sandflats or mudflats, or ones covered with seagrass, often near mangroves. It roosts during high tide on sandy spits, sandbars, and islets, especially on beach sand, and among coastal vegetation, including mangroves. As with other species, it seeks roost sites where damp substrate lowers local temperatures in hot conditions (DoE, 2015b). Historically, in the NT, it has most commonly been recorded in mangrove habitat (Ward, 2012).

Lilleyman *et al*. (2018, 2020b) recorded the distribution of the *N. madagascariensis* in the Darwin Harbour at low tide and at high tide during a spring tide in 2017 and 2020. The spring tide occurs twice per lunar month when the high and low tides are at their cyclical highest and lowest. This study found *N. madagascariensis* prefers foraging habitats close to suitable saltpan roosting habitat, and roosting habitat close to foraging habitat. A tracking study found the species to maintain small home ranges, which is typical of territorial species (Lilleyman & Garnett, 2019). At the peak of the tide, when the saltpans were inundated, birds moved to two key locations – a large saltpan near the ConocoPhillips 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 (maximum count of 329 birds in January 2017), or close to 1% of the global population of *N. madagascariensis* roost there during the highest tides. Nationally significant aggregations (i.e. occurrences of ≥ 0.1% of the total EAAF population) are known to occur in the Darwin Harbour Proper (Lilleyman *et al*., 2018, 2020b).

The number of birds has been recorded to be increasing in recent years (Lilleyman & Garnett, 2019), although not significantly (Lilleyman *et al.* 2020a). Lilleyman *et al.* (2018) speculate the increase is a result of the increased availability of Spring high tide roosting habitat at East Arm Wharf. Lilleyman *et al*. (2020b) recorded lower numbers (low tide: total count 158, high tide: total count 86); however, maximum tide was lower than in 2017 and many birds were thought to be in the mangroves and thus unrecorded in 2020.

Figure 3-1 shows the 266 records of *N. madagascariensis* available from the NT Fauna Atlas for the Darwin Harbour.

3.1.1.3 Suitable Habitat in Relation to the Project Area

The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat for *N. madagascariensis*. The saltpan area within Lot 1817 and the mangrove habitat adjacent is suitable roosting habitat for this species. **Figure 3-2** shows the locations of *N. madagascariensis* recorded in field surveys initiated by TNG in December 2018 and March 2019 in relation to the Development Envelope. These records show *N. madagascariensis* utilising the mudflats for foraging (8 records), the mangroves for foraging and roosting (12 records), and the saltpan area within Lot 1817 for roosting at high tide (7 records). Only one record occurred in 2019, and the records in 2018 were taken across 3 tides per day for 4 days using both helicopter and boat. The maximum number of Far Eastern Curlew recorded in the area within or adjacent to Lot 1817 within a single survey is 4 individuals.

Numenius madagascariensis does not breed in Australia so there is no suitable breeding habitat. Habitat in the intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by the historic use of Lot 1817 for extractive industries and the unregulated access of humans, dogs, motorbikes and invasive fauna such as cats and pigs. The site hydrology has been altered by the former extractive industry where the upper lateritic aquifer material has been removed and soil bunding has been left in many places which is likely to have altered the natural surface and subsurface hydrological processes on the site.

3.1.1.4 Life History and Migration Patterns

Numenius madagascariensis may delay breeding until 3-4 years of age and can live for over 19 years. It nests in small colonies, of 2-3 pairs, between early May to late June. The species is often recorded individually or in small flocks, but occasionally occurs in large flocks when feeding (DoE, 2015b).

At the end of the breeding season, *N. madagascariensis* migrates south. It departs eastern Russia from mid-July. Migration from the Yellow Sea to Australia typically occurs in a single, direct flight. It arrives in northwest and eastern Australia from July. The northern migration begins in late February and continues from March to April. Many individuals spend their first and second austral winter in Australia, with some also spending their third

(DoE, 2015b). Lilleyman and Garnett (2019), have found February to be the month where the highest number of Far Eastern Curlew are recorded at the East Arm Wharf in the Darwin Harbour.

Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (July – April), while immature individuals may remain at the site throughout the austral winter (i.e. year-round until they sexually mature).

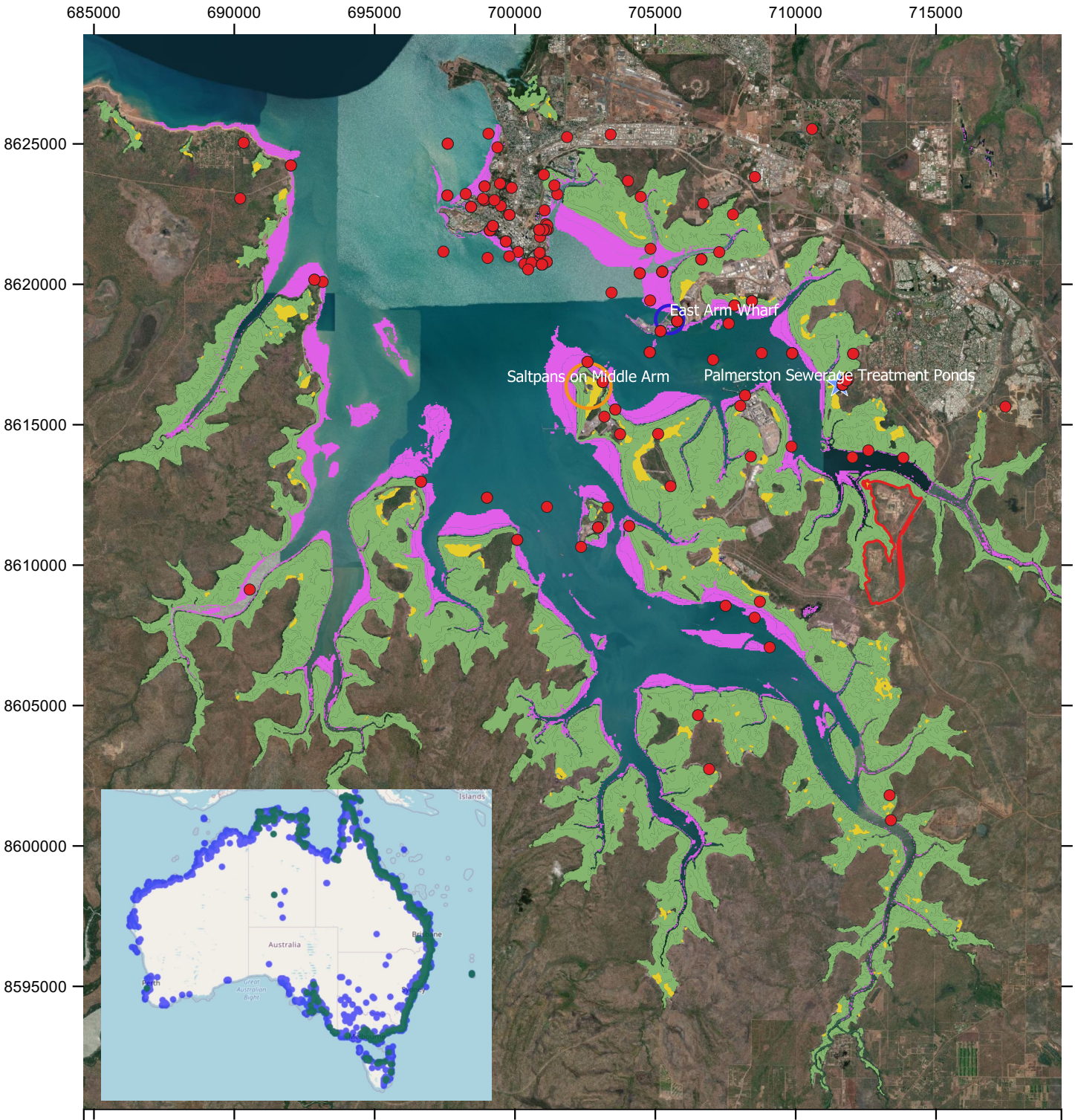


Figure 3-1. Distribution of Far Eastern Curlew records in Darwin Harbour Proper and (inset) Australia

Legend

Shorebird habitats
- Mangrove
- Saltpan
- Intertidal layer

DENR Database records
- Far Eastern Curlew

Lot 1817 boundary

Inset (Source: Atlas of Living Australia)
- All records
- Records 2010-2020

0 2.5 5 km

eleanor@animalplantmineral.com.au
date: 21/07/2020
CRS: GDA94 MGA Zone 52
basemap: ESRI

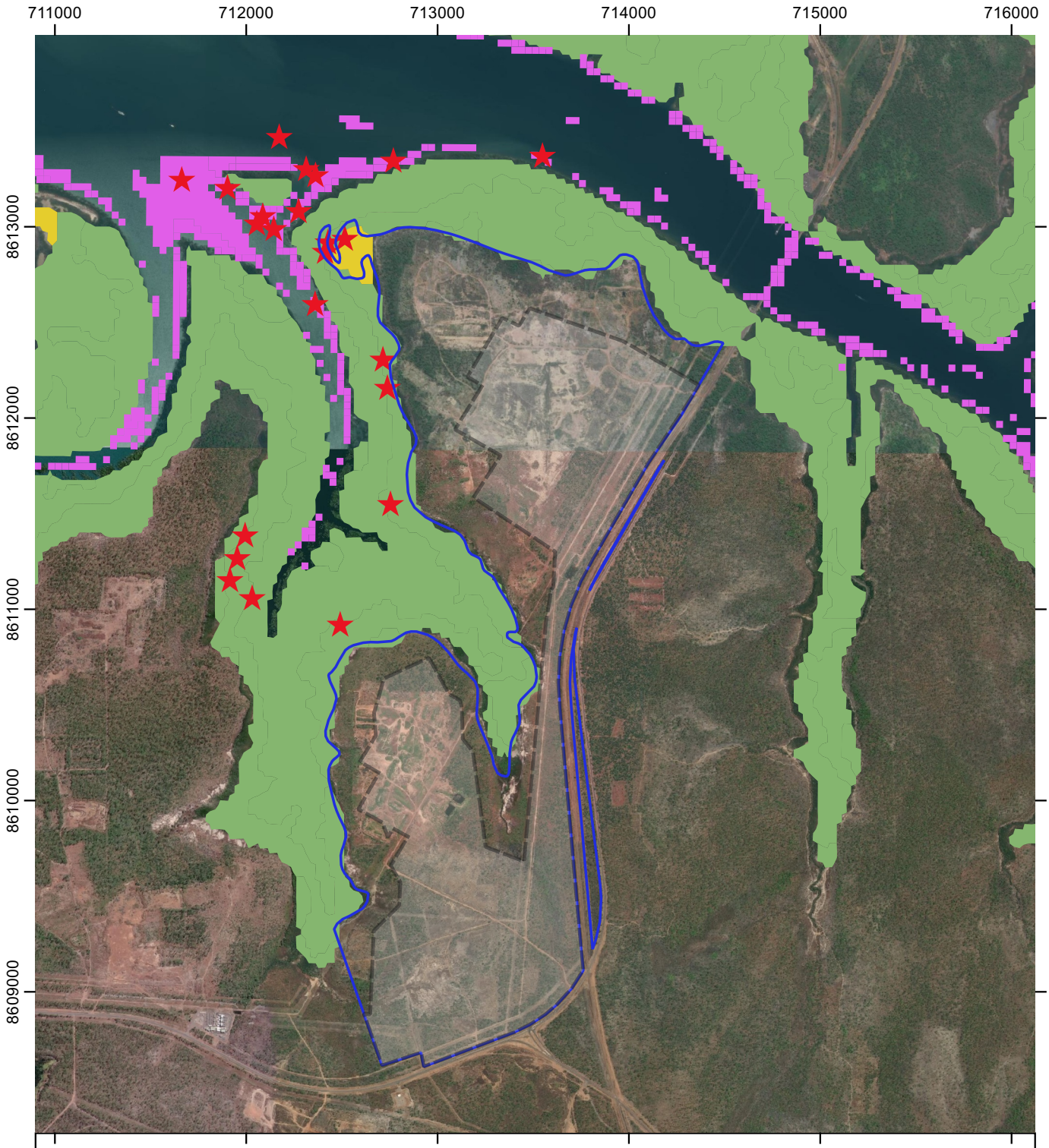


Figure 3-2.Distribution of Far Eastern Curlew and migratory shorebird habitats in relation to the Development Envelope

Legend

Shorebird habitats
- Mangrove
- Saltpan
- Intertidal layer

EIS Supplement Development Envelope

Lot 1817 boundary

APM Avifauna survey records
- Eastern Curlew

0 500 1000 m

eleanor@animalplantmineral.com.au
date: 19/01/2021
CRS: GDA94 MGA Zone 52
basemap: ESRI

3.1.1.5 Diet and Feeding Behaviour

In Australia, *N. madagascariensis* is carnivorous, feeding on crustaceans, molluscs, and some insects. It is both diurnal and nocturnal, feeding and roosting according to the tide. Individuals search for burrows of prey by sight in light conditions, or by touch when lighting is poor. Differences in body and bill morphology between sexes appears to drive differences in foraging behaviour and diet. Foraging occurs singly or in loose flocks (DoE, 2015b). Lilleyman *et al.* (2018) noted the preference for foraging at the upper half of the tidal mud flats where crab densities were highest, rather than following the receding tide all the way to the lowest point.

3.1.1.6 Threatening Processes

As with other migratory shorebirds, *N. madagascariensis* is sensitive to development due to its high site fidelity, tendency to aggregate, high energy demands, and need for habitat connectivity between roosting and foraging sites. In Australia, major threats include habitat loss and degradation, especially in southern sites, human disturbance, pollution, invasive plants, and changes to water regime. Sites in the NT are generally considered to be free of these threats (DoE, 2015b).

Internationally, the species is listed as EN by the IUCN. As with many charadriiforms, the key threat facing *N. madagascariensis* is habitat loss in the Yellow Sea area. Other recognised threats include:

- residential and commercial development
- agriculture and aquaculture
- biological resource use (*e.g*. hunting)
- pollution, and
- climate change and severe weather (BirdLife International, 2017c).

3.1.2 *Charadrius leschenaultii* – Greater Sand Plover

3.1.2.1 Description

Charadrius leschenaultii is a small to medium shorebird, reaching lengths up to 25 cm and weights of 100 g. It has a straight, long bill with a pointed tip. The non-breeding plumage is grey-brown, with a pale underbody, neck, and forehead. The breeding plumage is reddish from the breast to the forehead and back of the neck. Females and non-breeding individuals lack red colouration. Juvenile plumage is similar to non-breeding adults, with buff tinges to feathers of the upperparts and around the face. This species is easily confused with the smaller *C. mongolus* (TSSC, 2016c).

3.1.2.2 Distribution and Habitat

This species breeds in Mongolia, northwest China, and southern Siberia. At the end of the breeding season, an estimated 200,000-300,000 birds migrate south along the EAAF for the austral summer. An estimated 119,000 birds migrate to Australia in widespread locations around the coast, although most occur in the north. The estimated 40,300 birds that visit the NT have been recorded along most of the coastline, with most records from Joseph Bonaparte Gulf, the coast of Anson Bay to Murgenella Creek (including the south coast of the Tiwi Islands), northern Arnhem coast, and Port McArthur area (TSSC, 2016c). The Greater Darwin area is considered an internationally significant site (DAWE 2020), although recent count data do not exceed 1 % of the population (Chatto 2012). Surveys at Lee Point in the Greater Darwin area have recorded Greater Sand Plover in numbers exceeding the benchmark for nationally significant aggregation on one occasion between 1980 and 2018 (Lilleyman *et al.* 2020a).

In non-breeding areas, the species is almost exclusively coastal, inhabiting littoral and estuarine areas. It inhabits a variety of coastal habitats, including sheltered beaches, large intertidal mudflats, salt marshes, tidal lagoons, and coral reefs. It forages in wet sand or mud exposed by tides on mudflats of sheltered embayments, lagoons, or estuaries. It roosts on sandspits and banks on beaches or in tidal lagoons. It typically roosts further away from water on beaches than other shorebirds; however, like other species in hot conditions, it seeks areas with wet

substrates that have lower local temperatures (TSSC, 2016c).

This species has been recorded from the Elizabeth River adjacent to Lot 1817 (three records) in 2016, but not in 2018 or 2019. The NT Fauna Atlas includes 174 records within the Darwin Harbour, shown in **Figure 3-3**, with the closest record being at the Elizabeth River adjacent to Lot 1817. *Charadrius leschenaultii* is a frequent user of the East Arm Wharf, where a maximum of 560 birds have been counted in one year over the 2013-2018 period. The highest monthly counts occur in January-February and September-November (Lilleyman & Garnett, 2019). This qualifies the Darwin Harbour Proper as a nationally significant aggregation. The number of Greater Sand Plover visiting the East Arm Wharf has shown a significant reduction (12.7%) over the 9 years of monthly data to 2018.

3.1.2.3 Suitable Habitat in Relation to the Project Area

The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat for *C. leschenaultii*. The saltpan area within Lot 1817 may be suitable roosting habitat. This species does not breed in Australia so there is no suitable breeding habitat.

Habitat in the intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, however it is unknown how the condition has been previously impacted by the historic use of Lot 1817 for extractive industries and the unregulated access of humans, dogs, motorbikes and invasive fauna such as cats and pigs. The site hydrology has been altered by the former extractive industry where the upper lateritic aquifer material has been removed and soil bunding has been left in many places which is likely to have altered the natural surface and subsurface hydrological processes on the site.

3.1.2.4 Life History and Migration Patterns

This species can breed from approximately 2 years of age and live for nearly 13 years. It usually lays 3 eggs per clutch, in April and May, with eggs incubated by both parents for at least 24 days. Chicks fledge after 30 days. It is often seen in large flocks, especially with *C. mongolus* (TSSC, 2016c).

Once chicks are independent, *C. leschenaultii* departs breeding grounds between mid-June and early-August. It is one of the first shorebirds to reach northwest Australia for the non-breeding season, usually around late July, with adults arriving before juveniles. It has been hypothesised that *C. leschenaultii* only uses one major stopover during the southern migration. The species leaves northern Australia between February and April for its return northward migration (TSSC, 2016c).

3.1.2.5 Diet and Feeding Behaviour

This species predominantly consumes molluscs, worms, crustaceans, and insects during the non-breeding season. It forages in wet sand or mud exposed by tides, and employs a running, stopping, and pecking action, which includes gleaning the surface of the substrate or probing just below the surface for prey (TSSC, 2016c). it may wade in water that is belly-deep and will occasionally submerge its head to search for prey. It typically forages singly or in loose flocks with other shorebirds but avoids areas of high shorebird density during foraging (DAWE 2020).

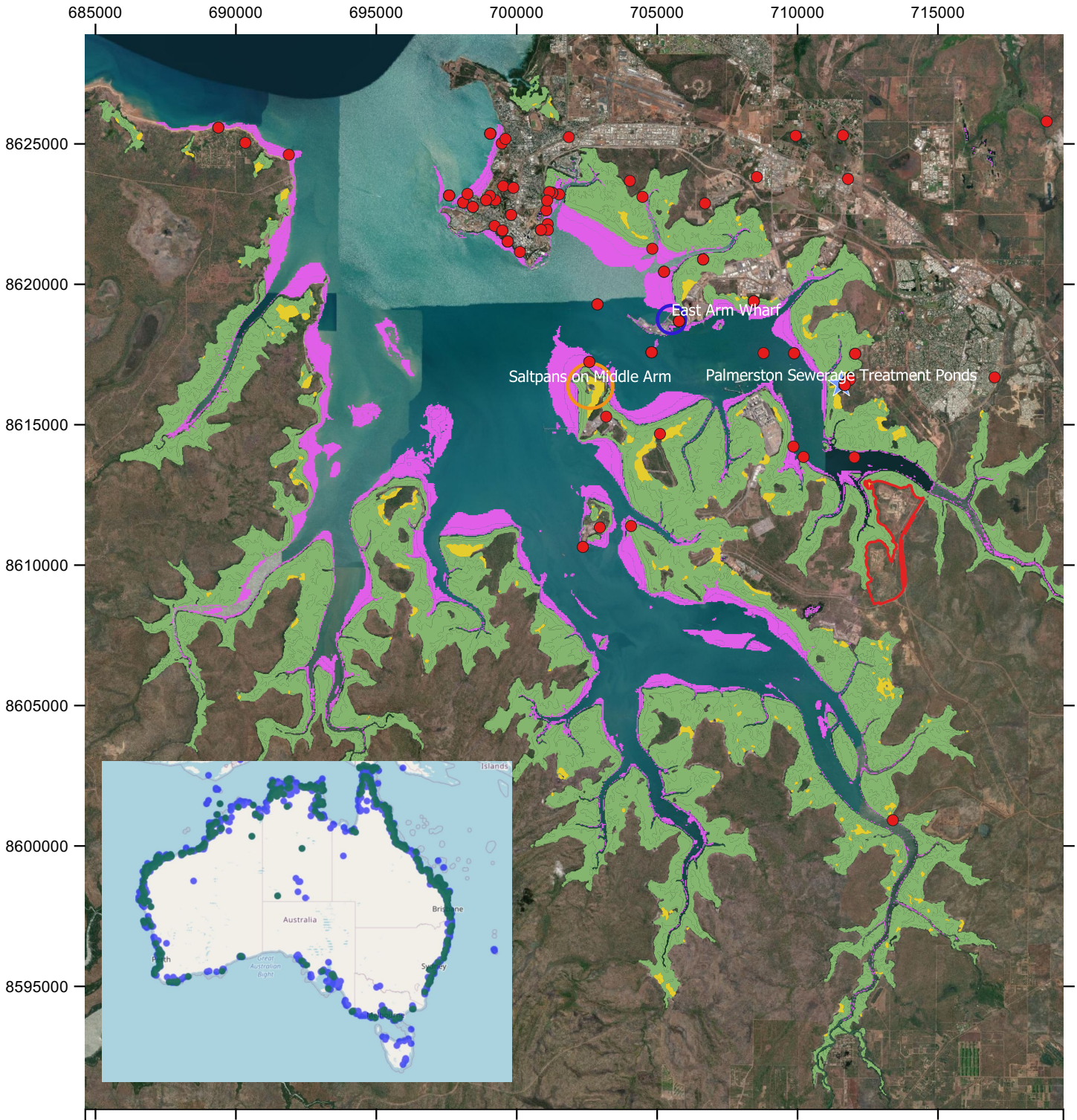


Figure 3-3. Distribution of Greater Sand Plover records in Darwin Harbour Proper and (inset) in Australia

Legend

Shorebird habitats
- Mangrove
- Saltpan
- Intertidal layer

DENR Database records
- Greater Sand Plover

Lot 1817 boundary

Inset (Source: Atlas of Living Australia)
- All records
- Records 2010-2020

0 2.5 5 km

eleanor@animalplantmineral.com.au
date: 21/07/2020
CRS: GDA94 MGA Zone 52
basemap: ESRI

3.1.2.6 Threatening Processes

As with other migratory shorebirds, *C. leschenaultii* is sensitive to development due to its high site fidelity, tendency to aggregate, high energy demands, and need for habitat connectivity between roosting and foraging sites. In Australia, major threats to *C. tenuirostris* include ongoing human disturbance, habitat loss and degradation (especially from residential, farming, industrial, and aquaculture/fishing activities), changes to water regimes, and invasive plants. Sites in the NT are generally considered to be free of such disturbances, making them priorities for protection (TSSC, 2016c).

Internationally, the species is listed as Least Concern by the IUCN. The key threat facing *C. leschenaultii* is habitat loss from the breeding range (particularly, the destruction of wetlands), favoured staging areas along the migration pathway (*e.g*. in Turkey and China), and non-breeding areas (*e.g*. agricultural development of coastal and inland habitat in Australia). Other recognised threats include:

- Residential and commercial development;
- Transportation and service corridors;
- Human intrusions and disturbance (particularly recreational activities);
- Invasive and other problematic species, genes, and diseases;
- Agriculture and aquaculture (*e.g*. from annual and perennial non-timber crops, and marine and freshwater aquaculture);
- Biological resource use (*e.g*. hunting); and
- Natural system modifications (*e.g*. dams and water management/use) (BirdLife International, 2019).

3.1.3 *Mesembriomys gouldii gouldii* – Black-footed Tree-rat (Kimberley and mainland Northern Territory subspecies), Djintamoonga, Manbul

3.1.3.1 Description

Mesembriomys gouldii is a robust, arboreal rodent, reaching weights of up to 830 g. It is one of Australia's largest murids. It has shaggy, grey to black fur on top, a pale underside, large, black ears, and a distinctive long, hairy tail, with a terminal white brush (Hill, 2012; TSSC, 2015b). Two subspecies of *Mesembriomys gouldii* have been identified: one from the Kimberley and mainland Northern Territory, *M. g. gouldii*, and a second from north Queensland, *M. g. rattoides*. This document addresses the former.

3.1.3.2 Distribution and Habitat

Mesembriomys gouldii gouldii is restricted to forests and woodlands of the north Kimberley, Western Australia (**WA**) and mainland NT. Its distribution is patchy and has contracted across its mainland range; however, the rate, timing, and extent of this contraction are poorly known. While the Conservation Advice for this species states "it may have disappeared from the Kimberley" as it had not been recorded in the region for more than 30 years, it was rediscovered by Department of Biodiversity, Conservation and Attraction staff in 2017 using remote camera traps (DBCA, 2017). In the NT, it has declined substantially in Kakadu National Park, as well as more broadly across the Top End. Importantly, it has not been reported from many islands in the NT; areas that usually provide refuge for species from mainland threats (Hill, 2012; TSSC, 2015b).

This species typically inhabits lowland open forests and woodlands dominated by Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*), and, preferentially, with a relatively dense shrubby understorey, resembling the habitat preferences of *Antechinus bellus* (Hill, 2012; TSSC, 2015b).

This species is known to occur in the Darwin region including within the Charles Darwin National Park (Hill, 2012) (**Figure 3-4**).

Mesembriomys gouldii gouldii has undergone notable declines in abundance, area of occupancy, and extent of occurrence in the past few decades (Woinarski, Burbidge, & Harrison, 2014). While there are no published

population estimates for subpopulations, or overall, Woinarski *et al.* (2014) estimated a greater than 50% reduction in population size in the past decade. Broad wildlife monitoring programs in three NT national parks, Kakadu, Litchfield, and Garig Gunak Barlu National Parks, have been unable to provide population trend data because of low capture rates, although the declines have been marked for the Kakadu area, and broadly across the Top End (TSSC, 2015b). Despite these declines, the species appears to be locally abundant in the Darwin peri-urban area (TSSC, 2015b).

3.1.3.3 Ecology

Mesembriomys gouldii gouldii is nocturnal and are known to be solitary or gregarious. It predominantly dens in tree hollows, but is also known use dense foliage, especially of *Pandanus* species. It forages on the ground in trees, with the diet largely consisting of fruits (including from *Pandanus spiralis*) and seeds, supplemented with invertebrates, flowers, and grass. Individuals may move large distances from den sites to forage (Hill, 2012; TSSC, 2015b).

This species can breed throughout the year; however, in the NT, breeding peaks in the dry season, between August and September. Litters are small, at one to three young, with females able to breed every nine months. Gestation is between 43-44 days, and young are weaned within four weeks. Individuals reach sexual maturity at approximately three months, and likely live between three and five years (Hill, 2012; TSSC, 2015b).

Black-footed Tree-rats spend their entire life cycle within a home range, and perform all foraging, resting and breeding behaviours within that area. Black-footed Tree-rats forage on the ground and in trees, with an average home range in un-fragmented open forests of 67.3 ± 10.4 hectares and in fragmented habitat of 27.1 ± 8.4 ha (Rankmore 2006). Rankmore (2006) demonstrates Black-footed Tree Rat do not occupy disturbed areas but if inhabiting fragmented habitats, they may cross disturbed areas into other habitat fragments. They may travel up to 2 km in one night (Rankmore 2006).

3.1.3.4 Suitable Habitat in Relation to the Project Area

This species has been recorded 19 times within the Project area during surveys by APM and GHD in 2017 – 2019. Locations within Lot 1817 are shown in **Figure 3-5**. A road mortality is also recorded in the NT Fauna Atlas (DENR, 2019) from 2016 on Channel Island Road west of the Project area.

The DEPWS Flora and Fauna Division have conducted a camera trapping exercise on the Middle Arm Peninsula (**Figure 3-6**) covering approximately 3000 ha. Results show that Lot 1817 is in the centre of a population of Black-footed Tree-rat that occupies the centre of Middle Arm but not the western extent (**Figure 3-6**). All camera traps to the east of Lot 1817 also recorded Black-footed Tree-rat and it is likely the species continues to the east past the end of the camera traps, as suitable habitat is continuous and undisturbed in that direction.

Habitat suitability within Lot 1817 is high in the Eucalyptus woodland habitat type. The availability of tree hollows is likely limited at Lot 1817. The NT Land Clearing Guidelines indicate tree hollows are particularly prevalent in trees with a diameter at breast height (DBH) ≥ 50 cm. All trees in Lot 1817 were systematically measured for DBH. Four small pockets of trees totalling 3.7 ha were found to have the required density of trees with DBH ≥ 50 cm to be considered as significant habitat. The remaining remnant Eucalypt woodland contains trees of a smaller size and thus less likely to have developed a significant tree hollow availability. It is likely *M. g. gouldii* individuals inhabiting the site are utilising the commonly available *Pandanus* foliage for denning rather than tree hollows. The habitat in Lot 1817 is approximately 4% of the available habitat in the central portion of Middle Arm.